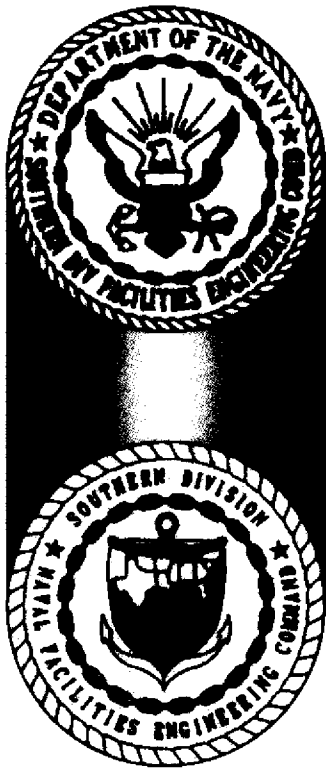


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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
ADDENDUM CORRECTIVE MEASURES STUDY WORK PLAN AREA OF CONCERN 596
(AOC 596) ZONE E CNC CHARLESTON SC
5/9/2003
CH2M HILL

RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan AOC 596. Zone E



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

CH2M Jones

May 2003

Contract N62467-99-C-0960



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May 9, 2003

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: RFI Report Addendum and CMS Work Plan (Revision 1) – AOC 596, Zone E

Dear Mr. Scaturo:

Enclosed please find four copies of the RFI Report Addendum and CMS Work Plan (Revision 1) for AOC 596 in Zone E of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Sam Naik. Please do not hesitate to contact him at 770/604-9182, extension 255, should you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Dann Spariosu/USEPA, w/att
Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

**THE ATTACHED PAGES SHOULD BE INSERTED AS REPLACEMENTS IN THE
RFI REPORT ADDENDUM AND CMS WORK PLAN, AOC 596, ZONE E, REVISION 0
SUBMITTAL:**

- **REVISED PGS. 5-4 AND 5-5**
 - **REVISED FIGURE 2-1**
-



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November 20, 2002

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: RFI Report Addendum and CMS Work Plan (Revision 0) – AOC 596, Zone E

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RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan AOC 596, Zone E



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

PREPARED BY
CH2M-Jones

May 2003

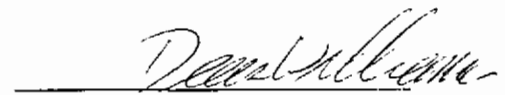
Revision 1
Contract N62467-99-C-0960
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Certification Page for RFI Report Addendum and CMS Work Plan (Revision 1) – AOC 596, Zone E

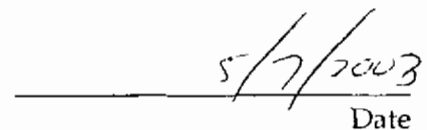
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428

A handwritten signature in cursive script, appearing to read "Dean Williamson", is written over a horizontal line.

Dean Williamson, P.E.

A handwritten date "5/7/2003" is written over a horizontal line. Below the line, the word "Date" is printed.

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1 Acronyms and Abbreviations

2	AOC	Area of concern
3	AST	Aboveground storage tank
4	BCT	BRAC Cleanup Team
5	BEQ	Benzo[a]pyrene equivalent
6	BRAC	Base Realignment and Closure Act
7	BRC	Background reference concentration
8	CA	Corrective action
9	CMS	Corrective measures study
10	CNC	Charleston Naval Complex
11	COC	Chemical of concern
12	COPC	Chemical of potential concern
13	CSI	Confirmatory Sampling Investigation
14	DAF	Dilution attenuation factor
15	EnSafe	EnSafe Inc.
16	EPA	U.S. Environmental Protection Agency
17	FRE	Fixed-point risk evaluation
18	HHRA	Human Health Risk Assessment
19	HI	Hazard index
20	ILCR	Incremental lifetime cancer risk
21	IM	Interim measure
22	LUC	Land use control
23	MCL	Maximum contaminant level
24	MCS	Media cleanup standard
25	µg/kg	Micrograms per kilogram
26	µg/L	Micrograms per liter
27	mg/kg	Milligrams per kilogram
28	NAVBASE	Naval Base
29	NFA	No further action

1 **Acronyms and Abbreviations, Continued**

2	NFI	No further investigation
3	OWS	Oil/water separator
4	PAH	Polycyclic aromatic hydrocarbon
5	RAO	Remedial action objective
6	RBC	Risk-based concentration
7	RCRA	Resource Conservation and Recovery Act
8	RFI	RCRA Facility Investigation
9	RGO	Remedial goal option
10	RI	Remedial investigation
11	SAP	Sampling and Analysis Plan
12	SCDHEC	South Carolina Department of Health and Environmental Control
13	SSL	Soil screening level
14	SVOC	Semivolatile organic compound
15	SWMU	Solid waste management unit
16	TTAL	Target treatment action level
17	VOC	Volatile organic compound
18	UST	Underground storage tank

1.0 Introduction

In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and transition of property to the community. The Charleston Naval Complex (CNC) was formed as a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1, 1996.

Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA), with the South Carolina Department of Health and Environmental Control (SCDHEC) as the lead agency for CA activities at the CNC. All RCRA CA activities are performed in accordance with the Final Permit (Permit No. SC0 170 022 560).

In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at the CNC. This submittal has been prepared by CH2M-Jones to complete the RCRA Facility Investigation (RFI) for Area of Concern (AOC) 596 in Zone E of CNC. The location of this site in Zone E is shown in Figure 1-1. Figure 1-2 shows an aerial photograph of the site.

1.1 Background

AOC 596 is comprised of Building 101, which is located at the intersection of Ninth Street and Pierside Street in Zone E of the CNC. Building 101 was built in 1919 and used to store torpedoes until 1943. From 1943 to 1946, the building housed a machine shop. In 1946, the building was converted into a storehouse for diesel parts and in 1947 it was used as a storehouse for the galvanizing plant. From 1981 to approximately 1995, it was used to store radioactive-contaminated material. No evidence of remnant radioactive contamination was found in the building during a survey conducted by the Navy prior to base closure. Currently, the building is vacant.

A review of the historical engineering drawings for this site shows that in 1922 a railroad line ran into the northeast side of Building 101. A 1952 drawing indicated that between 1939 and 1952 the railroad line was replaced with a new line going into the northeast side of Building 101 to make room for an additional rail line adjacent to Building 101. Between 1955 and 1952 the railroad line was removed and replaced with a paved road. Currently a railroad line runs adjacent to the north side of Building 101. Historic railroad locations are shown in Figure A-1 in Appendix A of this document.

The materials of concern that were identified based on historical operations for AOC 596 in the *Final Zone E RCRA Facility Investigation (RFI) Work Plan, Revision 1* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995) include solvents, degreasers, explosives, propellants, and petroleum hydrocarbons. This area of Zone E is zoned M-2 (industrial land use).

1.2 Purpose of the RFI Report Addendum

The purpose of this RFI Report Addendum is to document the results of previous RFI investigations conducted by EnSafe at AOC 596. This RFI Report Addendum also discusses the findings of previous investigations, existing site conditions, and surrounding area land use. The CNC RCRA Permit identified AOC 596 as requiring a Corrective Study Investigation (CSI). Although the site is zoned for industrial land use, a focused Corrective Measures Study (CMS) Work Plan is also provided in this submittal, in order to address potential remedies for chemicals of concern (COCs) detected in site surface soil.

Prior to changing the status of any site in the CNC RCRA CA permit, the BRAC Cleanup Team (BCT) agreed that the following issues should be considered:

- Status of the RFI
- Presence of metals (inorganics) in groundwater
- Potential linkage to Solid Waste Management Unit (SWMU) 37, Investigated Sanitary Sewers at the CNC
- Potential linkage to AOC 699, Investigated Storm Sewers at the CNC
- Potential linkage of AOC 504, Investigated Railroad Lines at the CNC
- Potential linkage to surface water bodies (Zone J)
- Potential contamination associated with oil/water separators (OWSs)
- Relevance or need for land use controls (LUCs) at the site

Information regarding these issues is provided in this RFI Report Addendum to expedite evaluation of closure of the site.

1.3 Report Organization

This RFI Report Addendum consists of the following sections, including this introductory section:

1.0 Introduction – Presents the purpose of the report and background information relating to the RFI Report Addendum.

2.0 Summary of RFI Conclusions for AOC 596 – Summarizes the conclusions from the RFI investigations and risk evaluations for AOC 596 as presented in *the Zone E RFI Report, Revision 0* (EnSafe, 1997).

3.0 Summary of Interim Measures and UST/AST Removals at AOC 596 – Provides information regarding any interim measures (IMs) or tank removal activities performed at the site.

4.0 Summary of Additional Investigations – Summarizes information, if any, collected after completion of the *Zone E RFI Report, Revision 0*.

5.0 COPC/COC Refinement – Provides further evaluation of chemicals of potential concern (COPC) based on RFI and additional data to assess them as COCs.

6.0 Summary of Information Related to Site Closeout Issues – Discusses the various site closeout issues that the BRAC Cleanup Team (BCT) agreed to evaluate prior to site closeout.

7.0 Recommendations – Provides recommendations for proceeding with a corrective measures study (CMS).

8.0 CMS Work Plan for AOC 596 - Provides a focused workplan for the CMS that is recommended for AOC 596.

9.0 References – Lists the references used in this document.

Appendix A – Includes Figure A-1, Historical Railroad Location Map (November 3, 1955), depicting the presence of railroad lines at the site.

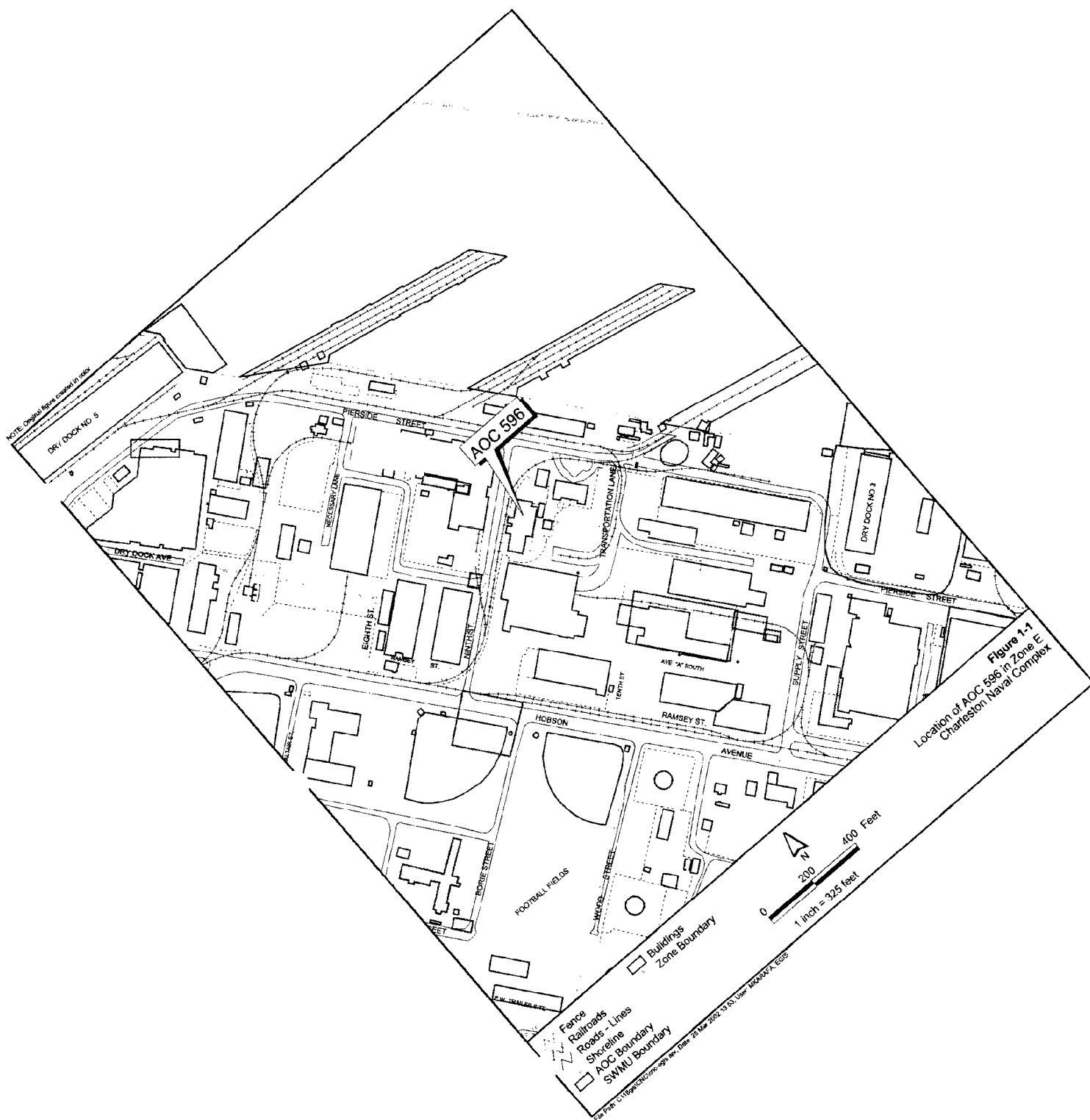
Appendix B – Contains excerpts from the *Zone E RFI Report, Revision 0*, including a summary of detections of chemicals and a groundwater flow map for the site vicinity.

Appendix C – Contains responses to SCDHEC comments for AOC 596 from the *Zone E RFI Report, Revision 0*.

Appendix D – Contains the analytical data results and the data validation summary for the sampling conducted at AOC 596 in September 2002.

Appendix E – Contains site photographs (Figures E-1 and E-2) which show the proximity of the railroad lines to the sampling locations north of Building 101.

All figures and tables appear at the end of their respective sections.



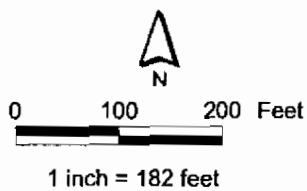
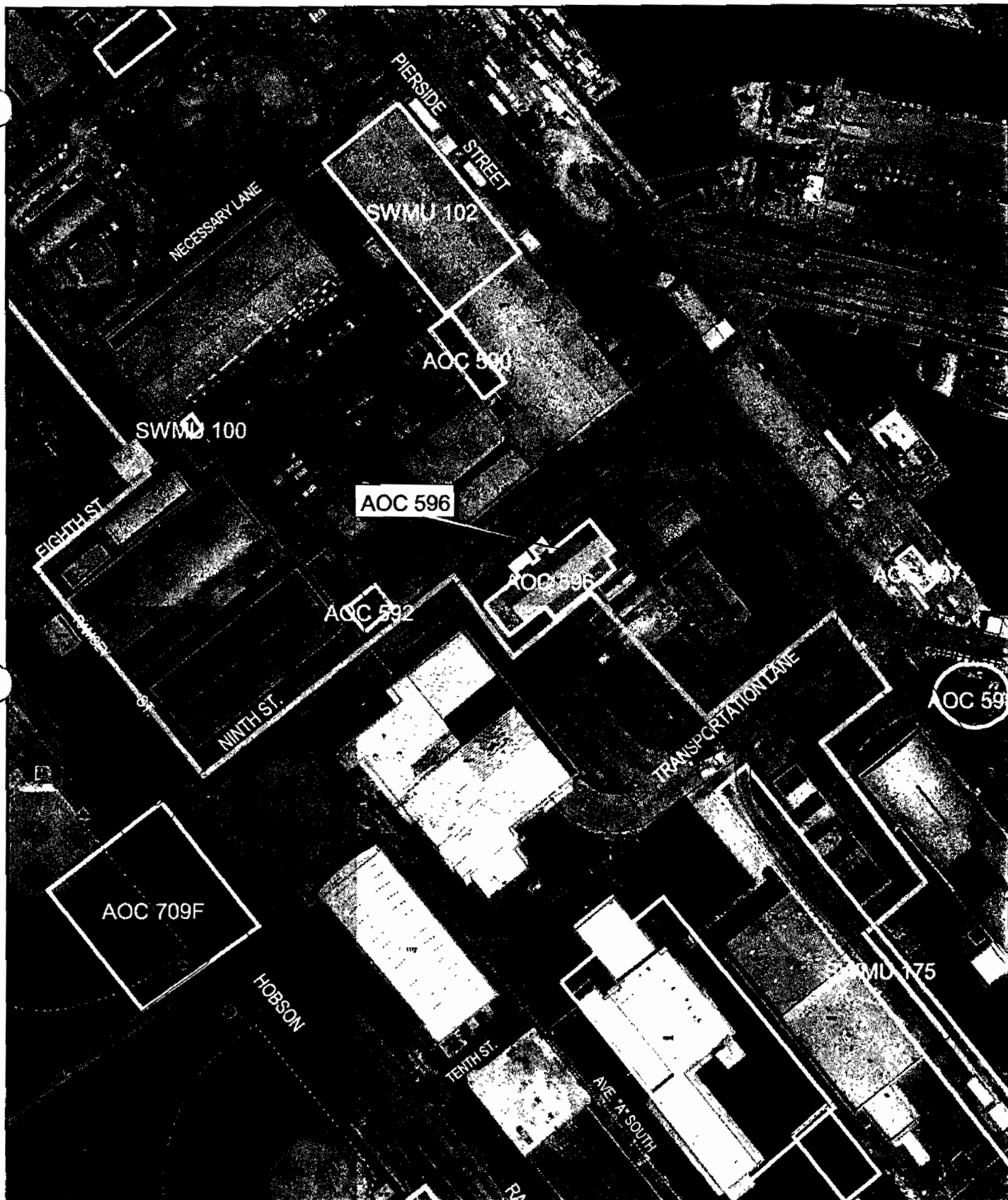


Figure 1-2
 Site Map
 AOC 596, Zone E
 Charleston Naval Complex

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2.0 Summary of RFI Conclusions for AOC 596

This section summarizes the results and conclusions from the soil and groundwater investigations conducted at AOC 596, as reported in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). Figure 2-1 shows soil and groundwater sampling locations. Appendix B contains the relevant excerpts from the *Zone E RFI Report, Revision 0*, which include a summary of detections of chemicals and a groundwater flow map for the site vicinity.

As part of the Zone E RFI, soil and groundwater investigations were conducted at AOC 596 during 1995 and 1996. The RFI report presented the results of these investigations and conclusions concerning contamination and risk, as summarized in the following sections. A further evaluation of the COCs identified at this site is provided in Section 5.0. Appendix C contains CH2M-Jones' responses to comments prepared by SCDHEC regarding the AOC 596 portion of the *Zone E RFI Report, Revision 0*.

2.1 Soil Sampling and Analysis

Soil was sampled during two sampling events at AOC 596. During the first event, eleven surface samples and eight subsurface soil samples were collected around the perimeter of Building 101. The site is paved except for around the southwest side of Building 101, where surface soils are exposed. The soil boring locations were identified as E596SB001 through E596SB011. All samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals.

During the second sampling event at AOC 596, surface and subsurface soil samples were collected at one additional location to define the outer extent of the exceedances of screening criteria detected during the first event. This sample location, which is within a paved area, was identified as E596SB012. The samples were analyzed for VOCs, SVOCs, pesticides, and metals.

2.1.1 Surface Soil Results

During the RFI, surface soil detections of organic compounds were evaluated against the U.S. Environmental Protection Agency (EPA) Region III industrial risk-based concentrations (RBCs) (with a hazard index [HI]=0.1 for noncarcinogens). Surface soil detections of inorganic compounds were evaluated against the EPA Region III industrial

RBCs (HI=0.1 for noncarcinogens) and the Zone E background reference concentrations (BRCs).

Detected concentrations of organic and inorganic analytes exceeding their respective criteria were as follows:

- **VOCs:** No VOCs exceeded the screening criteria in surface soils.
- **SVOCs:** The RFI report stated that among detected SVOC compounds, calculated benzo[a]pyrene equivalent (BEQ) values at two sample locations exceeded the industrial RBC of 780 micrograms per kilogram ($\mu\text{g}/\text{kg}$) for benzo[a]pyrene. There were no other exceedances of SVOC compounds in surface soils above screening criteria.
- **Inorganics:** Among detected inorganic analytes, only arsenic exceeded the screening criteria used in the RFI, which were the industrial RBC of 3.8 milligrams per kilogram (mg/kg) and the Zone E BRC of 23.9 mg/kg . The exceedance occurred at one location (E596SB006) with a concentration of 155 mg/kg .
- **Pesticides:** There were no pesticide exceedances in surface soil samples from AOC 596.

2.1.2 Subsurface Soil Results

During the RFI, subsurface soil detections of organic compounds were compared with generic soil screening levels (SSLs) using a dilution attenuation factor (DAF)=10, and the Zone E BRCs. Subsurface soil detections of inorganic compounds were compared with generic SSLs (using a DAF=10) and the Zone E BRCs.

Detected concentrations of organic and inorganic compounds from subsurface soil samples are as follows:

- **VOCs:** No VOCs exceeded the screening criteria in subsurface soils.
- **SVOCs:** The RFI report stated that among detected SVOC compounds, chrysene, isophorone, and n-nitroso-di-n-propylamine concentrations were detected above their respective screening criteria. Chrysene was detected in sample location E596SB006 at 1,800 $\mu\text{g}/\text{kg}$, which exceeds its SSL of 1,000 $\mu\text{g}/\text{kg}$. Isophorone was detected in sample location E596SB005 at 1,500 $\mu\text{g}/\text{kg}$, which exceeds its SSL of 200 $\mu\text{g}/\text{kg}$. N-nitroso-di-n-propylamine was detected in sample location E596SB005 at 500 $\mu\text{g}/\text{kg}$, which exceeds its SSL of 200 $\mu\text{g}/\text{kg}$. There were no other exceedances of SVOC compounds in subsurface soils above screening criteria identified.
- **Inorganics:** Among detected inorganic analytes, only arsenic and barium exceeded their respective screening criteria. Arsenic was detected in sample location E596SB007 (at 22 mg/kg), E596SB010 (at 38.7 mg/kg), and E596SB011 (at 21 mg/kg), exceeding its SSL of

- 1 15 mg/kg and Zone E BRC of 19.1 mg/kg. Barium was detected in E596SB006 (at 96.4
2 mg/kg), which exceeded both the SSL of 32 mg/kg and Zone E BRC of 94.1 mg/kg.
3 • **Pesticides:** There were no pesticide exceedances in subsurface soil samples from AOC
4 596.

5 **2.2 Groundwater Sampling and Analysis**

6 During the RFI for AOC 596, four shallow and two deep groundwater monitoring wells
7 were installed. Each well was sampled four times between 1996 and 1997. Groundwater
8 samples were submitted for VOCs, SVOCs, and metals analysis during the four sampling
9 events (see Figure 2-1 for well locations).

10 During the RFI, detections in groundwater samples were compared with the EPA Region III
11 tap water RBCs, maximum contaminant levels (MCLs), and the Zone E BRCs for shallow
12 and deep aquifers.

13 **2.2.1 Shallow Groundwater Results**

14 The following detections were found in the shallow groundwater at the site:

15 **VOCs:** There were no detections above laboratory detection limits.

16 **SVOCs:** There were no detections above laboratory detection limits.

17 **Inorganics:** The *Zone E RFI Report, Revision 0* reported detections in the first sampling event
18 only. Among detected inorganic analytes, only iron at a concentration of 11,000 micrograms
19 per liter ($\mu\text{g/L}$) in E596GW001 exceeded both its secondary MCL of 300 $\mu\text{g/L}$ and the tap
20 water RBC of 1,100 $\mu\text{g/L}$ (using a hazard index [HI]=0.1).

21 **2.2.2 Deep Groundwater Results**

22 The following detections were found in the deep groundwater at the site:

23 **VOCs:** There were no detections above laboratory detection limits.

24 **SVOCs:** There were no detections above laboratory detection limits.

25 **Inorganics:** The *Zone E RFI Report, Revision 0* reported detections in the first sampling event
26 only. Among detected inorganic analytes, only arsenic and iron exceeded their respective
27 screening criteria. Arsenic was detected at a concentration of 43.8 $\mu\text{g/L}$ in E596GW01D,
28 which exceeded both its deep groundwater Zone E BRC of 16.4 $\mu\text{g/L}$ and the tap water RBC
29 of 0.045 $\mu\text{g/L}$ (HI=0.1), but not its MCL of 50 $\mu\text{g/L}$. Iron was detected at a concentration of

8,170 µg/L in E596GW01D and 3,200 µg/L in E596GW06D, exceeding its tap water RBC of 1,100 µg/L. No primary MCL has been established for iron.

2.3 RFI Human Health Risk Assessment (HHRA)

These COPCs were further evaluated in a fixed-point risk evaluation (FRE) in the *Zone E RFI Report, Revision 0* to evaluate which of these parameters was considered a COC at AOC 596. Site resident and site worker scenarios were considered during the risk evaluation. The detailed risk assessment for the AOC 596 site is presented in Section 10.45.6 of the *Zone E RFI Report, Revision 0*.

2.3.1 Soils

The HHRA for AOC 596 identified arsenic and BEQs as COCs in surface soils for both the unrestricted (i.e., residential) land use and the commercial/industrial reuse scenarios. The FRE did not identify any COCs in subsurface soils at AOC 596.

2.3.2 Groundwater

The FRE for AOC 596 retained arsenic and lead as COCs in shallow groundwater. Lead was identified as a shallow groundwater COC during the risk assessment, based on one detection of 28.1 µg/L during the second sampling event in well E596GW002, which is above the target treatment action level (TTAL) for lead of 15 µg/L. Arsenic and thallium were retained as COCs for deep groundwater.

2.4 RFI Conclusions and Recommendations

The *Zone E RFI Report, Revision 0* recommended that a CMS be conducted for surface soil COCs (arsenic and BEQs), shallow groundwater COCs (arsenic and lead), and deep groundwater COCs (arsenic and thallium) at AOC 596.

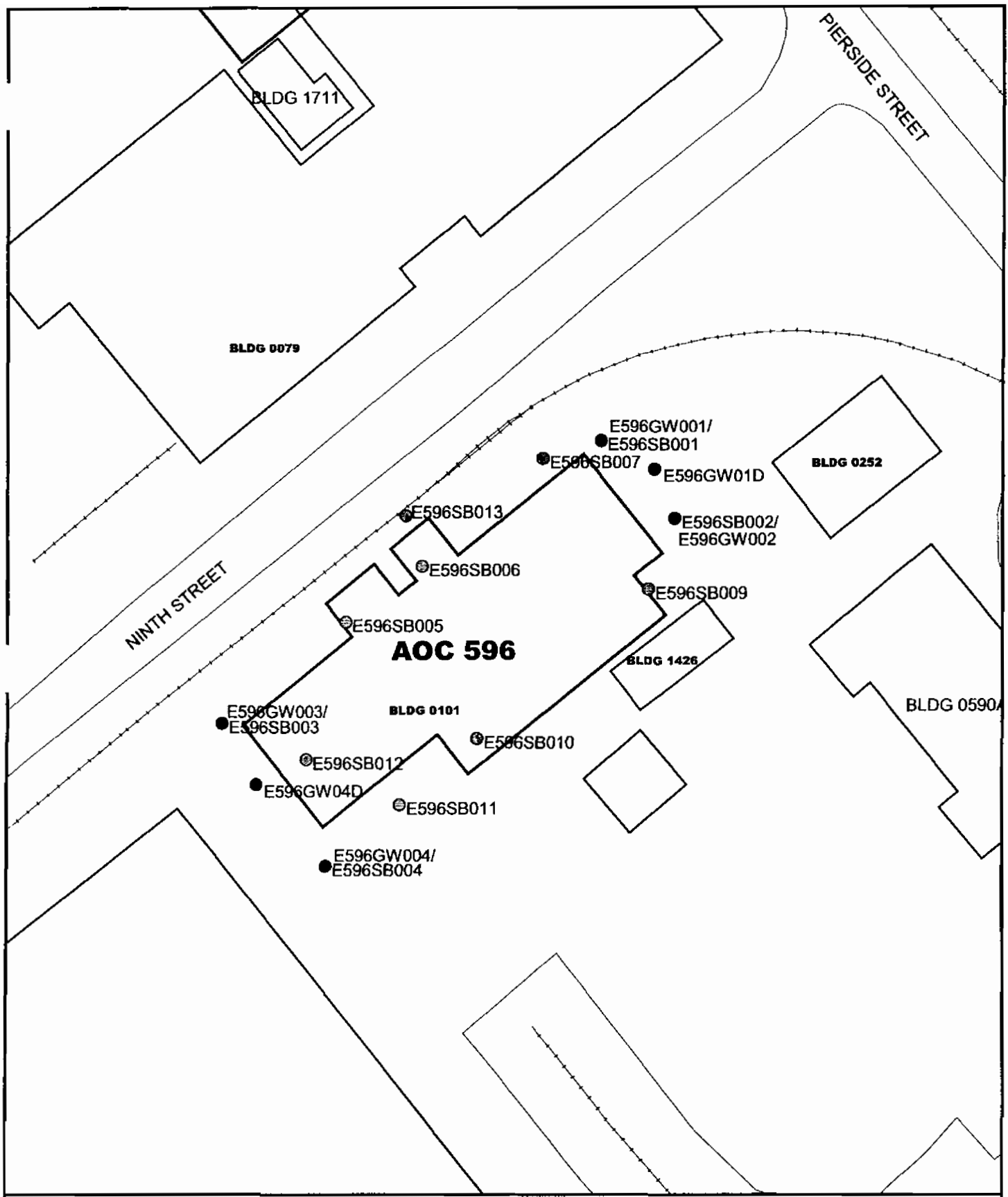


Figure 2-1
RFI Sampling Locations
AOC 596, Zone E
Charleston Naval Complex

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Section 3.0

3.0 Summary of Interim Measures and UST/AST Removals at AOC 596

3.1 UST/AST Removals

There is no indication of an underground storage tank (UST) or aboveground storage tank (AST) being present at AOC 596.

3.2 Interim Measures

No IMs have been conducted at the site.

1 4.0 Summary of Additional Investigations

2 This section summarizes the results and conclusions from an additional soil investigation
3 conducted at AOC 596 by CH2M-Jones during September 2002, whose purpose was to
4 further delineate the nature and extent of BEQs in surface soil. This investigation was
5 conducted to verify whether a source area for BEQs is present at the site, where elevated
6 BEQs were detected in the RFI soil boring location E596SB006.

7 As mentioned above, during the RFI, BEQs were detected in surface soil at boring location
8 E596SB006 at a concentration of 89.96 mg/kg, which exceeds the sitewide reference
9 concentration for BEQs in surface soil of 1.304 mg/kg. At this same location, BEQs were
10 detected in subsurface soil at a concentration of 2.116 mg/kg, which exceeds the sitewide
11 reference concentration for BEQs in subsurface soil of 1.4 mg/kg.

12 A sampling and analysis plan (SAP) for AOC 596 was prepared by CH2M-Jones and
13 submitted to SCDHEC. The soil sampling was conducted during September 2002. Appendix
14 D includes copies of the validated analytical results (along with a BEQ calculation table)
15 and data validation narratives for this sampling.

16 4.1 Soil Sampling and Analysis

17 In order to verify the presence of a BEQ source area near boring location E596SB006, one
18 additional soil boring was introduced at that location. The purpose of the resampling was to
19 assess whether significant BEQ contamination that might represent a source area was
20 present at this location. The soil boring was identified as E596SB014, and two samples were
21 collected from this boring and analyzed for SVOCs. Figure 4-1 shows the location where the
22 soil sampling was conducted. Table 4-1 presents the detections of SVOCs in these samples.

23 4.1.1 Surface Soil Results

24 Surface soil detections of SVOCs were evaluated against the EPA Region III residential
25 RBCs (with a HII=0.1 for noncarcinogens). There were no detections of carcinogenic
26 polycyclic aromatic hydrocarbons (PAHs) (i.e., BEQs) above laboratory detection limits in
27 the surface soil sample. Only two PAHs, fluoranthene and pyrene, were detected above
28 laboratory detection limits. Fluoranthene was detected at 0.0292 mg/kg, below its
29 residential RBC of 310 mg/kg, and pyrene was detected 0.028 mg/kg, below its residential
30 RBC of 230 mg/kg. The total BEQ value for this sample is 53.96 µg/kg, using half the

detection limit for the non-detects. Thus, the resampling at this location did not confirm the significant presence of BEQs or PAHs at this location.

4.1.2 Subsurface Soil Results

Subsurface soil detections were compared with generic SSLs (using a DAF=10). Only fluoranthene was detected above laboratory detection limits, at a concentration of 0.0249 mg/kg, below its SSL of 2,100 mg/kg. No BEQ compounds were detected above laboratory detection limits. The calculated total BEQ value for this sample (based on using half the detection limits for non-detects) is 55 $\mu\text{g/kg}$.

TABLE 4-1

Detected SVOCs in Soil, September 2002 Sampling

RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC ^a (HI=0.1)	SSL ^b (DAF=1)	Zone E Background Range of Conc.
Fluoranthene	Surface Soil				310	2,150	NA
	E596SB014	E596SB01401	29.2	J			
	Subsurface Soil				310	2,150	NA
	E596SB014	E596SB01401	24.9	J			
Pyrene	Surface Soil				230	2,100	NA
	E596SB014	E596SB01401	28	J			

^a SVOCs were evaluated against the EPA Region III residential risk-based concentrations (RBCs) (with a hazard index [HI]=0.1 for noncarcinogens).

^b SVOCs were screened using SSL (DAF=1). SSLs were obtained from Table A-1 of the *EPA Soil Screening Guidance: Technical Background Document* (1996).

DAF Dilution attenuation factor

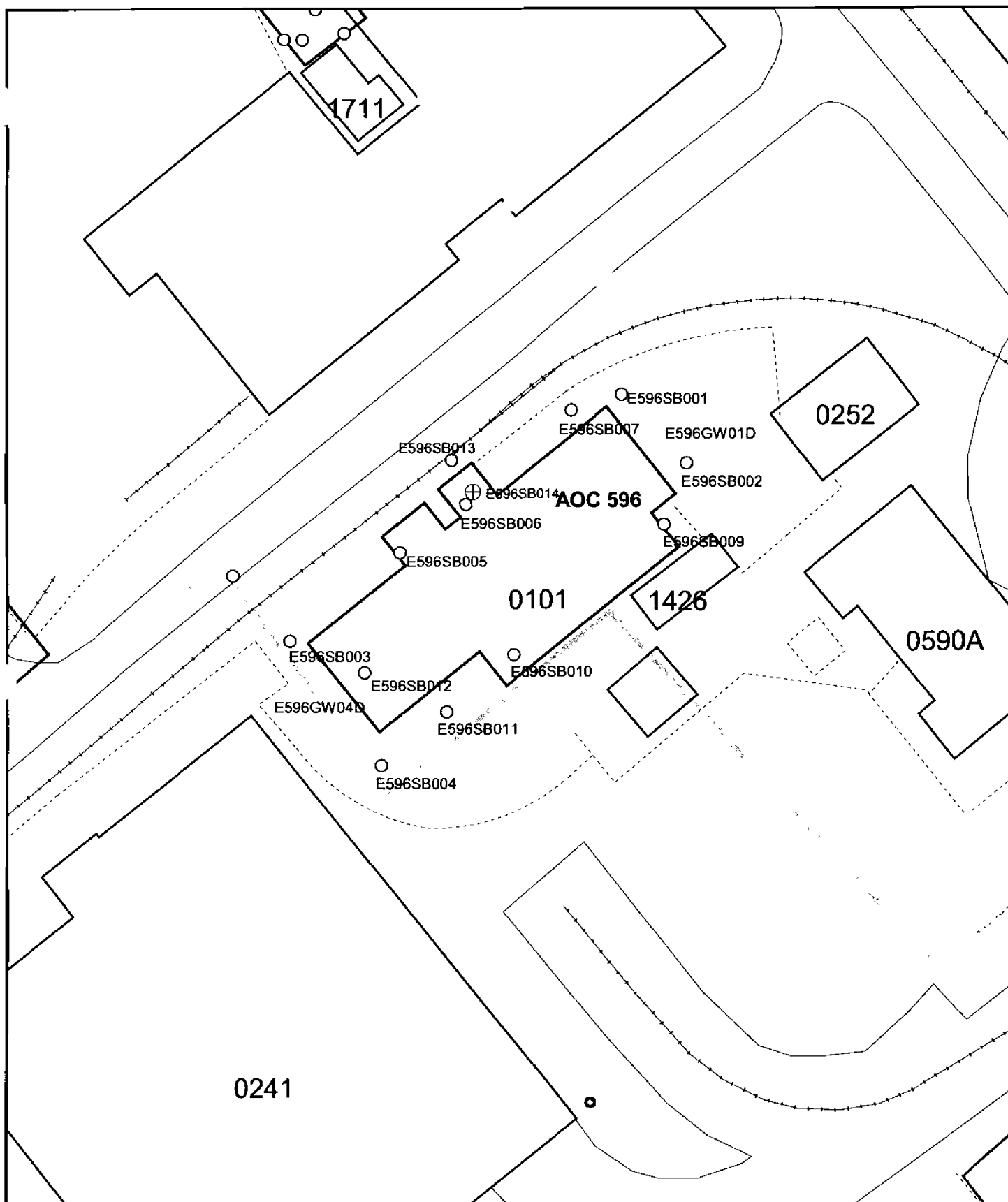
HI Hazard index

mg/kg Milligrams per kilogram

NA Not applicable

RBC Risk-based concentration

SSL Soil screening level



- ⊕ September 2002 Soil Sample Location
- RFI Surface Soil Sample Location
- Fence
- Railroads
- Roads
- AOC Boundary
- Buildings
- Zone Boundary

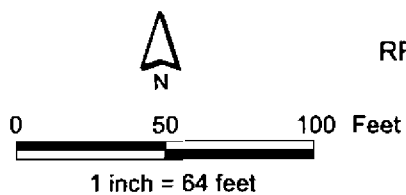


Figure 4-1
RFI and September 2002 Sample Location
AOC 596, Zone E
Charleston Naval Complex

5.0 COPC/COC Refinement

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified the following constituents as COCs at AOC 596 under the future industrial land use scenario: arsenic and BEQs in surface soil; arsenic and lead in shallow groundwater; and arsenic and thallium in deep groundwater. The nature of occurrence and the relevance of these chemicals at these sites are further discussed below. Table 5-1 presents the detections of arsenic and BEQs in soil. Table 5-2 presents detections of arsenic, lead and thallium in groundwater.

In addition to the original screening criteria, current screening criteria for Zone E includes comparing VOC concentrations in soil to SSLs with a DAF of 1. A generic SSL is not available for methyl ethyl ketone, therefore the RBC-based SSL value from the EPA Region III RBC table (1996) was used. Methyl ethyl ketone detections in soil did not exceed the EPA Region III RBC-based SSL. Methylene chloride was the only VOC detected above its generic SSL (with a DAF=1). Table 5-1 shows the detected concentrations of these chemicals. Methylene chloride is discussed further in Section 5.1.3.

5.1 Surface Soil COCs

5.1.1 Arsenic

During the RFI, arsenic was detected in all 12 samples, all of which exceeded the EPA Region III residential RBC of 0.43 mg/kg. Table 5-1 lists the detected arsenic concentrations in surface soil at AOC 596. Only one arsenic detection of 155 mg/kg (at E596SB006) exceeded the maximum Zone E background arsenic concentration of 68 mg/kg. The 95-percent Upper Confidence Limit (UCL_{95}) estimate (see Table 5-3) for arsenic with the elevated detection of 155 mg/kg included is 39.49 mg/kg (with a non-parametric distribution). With the elevated detection excluded, the UCL_{95} estimate is 10.6 mg/kg (with a log-normal distribution). Both of these UCL_{95} estimates are above the residential RBC of 0.43 at $HI=0.1$ as well as the industrial RBC of 3.8 mg/kg ($HI=0.1$).

The background soils at the CNC have been shown to have concentrations of arsenic above both the EPA Region III residential and industrial RBCs. Arsenic concentrations detected in background (grid) soil samples in Zone E ranged from 0.95 to 68 mg/kg, with a mean concentration of 8.5 mg/kg.

For sites where background arsenic levels exceed RBCs, EPA Region IV typically considers arsenic concentrations in surface soil of up to 20 mg/kg and 270 mg/kg as acceptable for unrestricted and industrial land use, respectively (EPA, 2001). Based on these criteria and the UCL₉₅ exposure concentration estimate of 39.49 mg/kg, arsenic would be considered a COC for unrestricted land use but not industrial land use.

As described earlier, if the single elevated arsenic value of 155 mg/kg from boring E596SB006 is removed from the data set, the calculated UCL₉₅ becomes 10.6 mg/kg, and the mean surface soil arsenic concentration becomes 8.6 mg/kg, which is similar to the mean background arsenic concentration for Zone E of 8.5 mg/kg. This indicates that arsenic in general is not significantly elevated at the site, and that the exceedance of the 20 mg/kg unrestricted land use criterion is driven largely by this single detection of 155 mg/kg.

On the basis of these considerations, arsenic in surface soil is considered a COC for unrestricted land use but not for industrial land use.

Figure A-1 in Appendix A shows the presence of historic railroad lines at the site from the Public Works Maps. The railroad lines were located in areas where the higher detections of arsenic were found during the RFI. These railroad line locations appear to have been paved over in subsequent Public Works Maps from the late 1930s and later, and currently remain paved over with concrete and asphalt. Currently, a railroad line runs adjacent to the north side of Building 101. While it is impossible to know with complete certainty what the origin of the elevated arsenic detected at boring E596SB006 is, the presence of historic railroad lines indicates the possibility that the arsenic may be elevated in this area of the site due to activities related to the railroad lines, rather than from releases or spills of arsenic-containing chemicals at the AOC.

A background concentration sampling effort conducted at the CNC for arsenic and BEQs along the railroad lines indicated a distribution of elevated concentrations of arsenic in surface soils around railroad lines and paved areas (CH2M-Jones, 2001). These elevated arsenic concentrations most likely occurred due to the use of arsenic-containing pesticides in railroad areas and around buildings. The range of arsenic concentrations detected in these samples was between 1.9 mg/kg and 92 mg/kg. Details of this study can be found in the *Technical Memorandum: Results from Additional Background Sampling of the CNC Railroad Lines and Naval Annex (Zone K)* (CH2M-Jones, 2001).

5.1.2 BEQs

Based on an evaluation using current screening criteria, BEQs were identified as requiring additional evaluation at one boring location. During the RFI, BEQs were detected in surface

soil at boring location E596SB006 at a concentration of 89.86 mg/kg, which exceeds the sitewide reference concentration for BEQs in surface soil of 1.304 mg/kg. At this same sample location, BEQs were detected in subsurface soil at a concentration of 2.116 mg/kg, which exceeds the sitewide reference concentration for BEQs in subsurface soil of 1.4 mg/kg. This sample location is also the location where arsenic was detected at an elevated concentration.

Due to the BEQ exceedance in soil boring E596SB006, additional soil sampling was performed by CH2M-Jones during September 2002 at AOC 596 to verify whether a source area of BEQs was present. The new soil boring, identified as E596SB014, was advanced and sampled for BEQs in the surface and subsurface soil intervals. BEQs were not detected above laboratory detection limits in the surface or subsurface soil samples collected from this boring location during the September 2002 sampling.

In order to further assess whether BEQs should be considered a COC at this site, a UCL₉₅ estimate was performed. The UCL₉₅ for BEQs in surface soil is 18.46 mg/kg, which exceeds the sitewide reference concentration for BEQs in surface soil of 1.304 mg/kg. These estimates are shown in Table 5-4. This BEQ UCL₉₅ estimate includes the previous BEQ detection of 89.862 mg/kg at E596SB006 from the RFI. The BEQ UCL₉₅ estimate calculated by replacing this previous RFI detection with the data from the resampling done at this location (sample ID E596SB01401) is 1.308 mg/kg, which is above the industrial RBC of 0.780 mg/kg for benzo[a]pyrene, but similar to the sitewide reference concentration for BEQs in surface soil.

Because all surface soils are under asphalt pavement, direct human exposure to these soils is not a concern at this site. On the basis of these observations, BEQs are considered a COC in surface soil for unrestricted and industrial land use at this site.

As with arsenic, it should be noted that the elevated BEQ detections occurred closest to the locations of the former railroad lines, suggesting that activities related to the presence of the railroad lines could be responsible for the elevated BEQ detections at this area of the site. Please see site photographs (included as Figures E-1 and E-2 in Appendix E) showing the proximity of the railroad lines to the sampling locations north of Building 101.

One exceedance of the CNC BEQ sitewide reference concentration for subsurface soils of 1.4 mg/kg was reported during the RFI at the same location (E596SB006). Resampling in this area did not detect BEQs above laboratory detection limits, indicating that the BEQ contamination that was previously detected is limited in extent, if present, and potentially resulting from entrainment of asphalt material in the soil sample collected from underneath

the asphalt pavement, rather than from a site-related release. Additionally, BEQ compounds were not detected above laboratory detection limits in the groundwater, indicating that the BEQs detected in surface soils do not pose a threat to groundwater via leaching. Therefore, BEQs are not considered a COC in subsurface soil.

5.1.3 Soil VOC Screening using SSL at DAF=1

Methylene chloride was detected in sample location E596SB006 at a concentration of 2 µg/kg, which exceeded the SSL of 1 µg/kg. The results of methylene chloride analyses in soil samples at AOC 596 are provided in Table 5-1. Methylene chloride was also detected in BLK0381440 and BLK0381442 of the laboratory QC blank samples associated with the AOC 596 sample data group at concentrations ranging from 1 µg/kg to 11 µg/kg, as shown in Appendix B of this report addendum. Methylene chloride is a recognized common laboratory contaminant and has been widely detected previously in many blanks associated with CNC samples. Based on EPA's "ten times rule," methylene chloride at concentrations up to 110 µg/kg may be considered as possible laboratory contamination. Because of its presence at relatively low concentrations in the laboratory blanks and in one site sample below 110 µg/kg, it is likely that methylene chloride detections are due to laboratory contamination. Therefore, methylene chloride is not considered a soil COC at this site.

5.2 Groundwater COCs

5.2.1 Arsenic

The RFI report considered arsenic as a COC based on the detections of arsenic above the EPA Region III tap water RBC in deep groundwater at AOC 596. The detections of arsenic in the deep well RFI samples ranged from 13.5 µg/L to 43.8 µg/L, which are below the State of South Carolina MCL for arsenic of 50 µg/L. Each of the wells was sampled during four sampling events. Based on the information presented above, arsenic is not considered a COC in groundwater at this site. Table 5-2 shows arsenic detections in groundwater.

5.2.2 Lead

The RFI report considered lead as a COC based on the detection of lead above the TTAL of 15 µg/L in E596GW002, at a concentration of 23.1 µg/L during the second sampling event. However, based on the rescreening of the data, lead did not exceed its maximum Zone E background concentration in shallow groundwater of 47 µg/L. Table 5-2 shows detections of lead in groundwater for this site.

1 It is also noted that no elevated lead concentrations were found in the soil samples. The
2 maximum detected concentration of lead in surface soil was 317 mg/kg, below the target
3 cleanup goal of 400 mg/kg for unrestricted land use. The maximum detected concentration
4 of lead in subsurface soil was 65.4 mg/kg, below the SSL of 400 mg/kg.

5 Based on these observations, lead is not considered a COC for groundwater at this site.

6 **5.2.3 Thallium**

7 The RFI report considered thallium a COC in both shallow and deep groundwater based on
8 the exceedance of the MCL of 2 µg/L in E596GW003 at a concentration of 6.7 µg/L in
9 shallow groundwater, and in E596GW04D at 7 µg/L in deep groundwater during the fourth
10 sampling event. Table 5-2 shows detections of thallium in groundwater.

11 The exceedance of the shallow groundwater MCL for thallium in the fourth sampling event
12 was preceded in three previous rounds with detections below laboratory detection limits.

13 The detection of thallium at 6.7 µg/L in deep groundwater did not exceed the maximum
14 Zone E thallium background concentration for deep groundwater of 7 µg/L. These
15 intermittent detections of thallium above MCL have been observed sitewide at CNC and
16 represent naturally occurring conditions. There is no indication that a release of thallium
17 has occurred in groundwater at the site due to site-related activities. Additionally, the
18 maximum surface soil thallium concentration detected during the RFI was 1.1 mg/kg,
19 below the maximum Zone E surface soil thallium background concentration of 2.8 mg/kg.

20 In subsurface soil samples from the RFI, the maximum thallium concentration detected
21 during the RFI was 2.3 mg/kg, above the generic SSL (with a DAF=10) for thallium of 0.4
22 mg/kg. No background concentrations have been established for subsurface soil in Zone E.

23 The lack of consistent detections of thallium in groundwater indicates that thallium
24 concentrations in soil are not a leaching concern at the site. Based on these observations,
25 thallium is not considered as a COC for groundwater at this site.

26 **5.3 COC Summary**

27 For the unrestricted land use scenario, arsenic is considered a surface soil COC. BEQs are
28 considered a COC in surface soil for the unrestricted and industrial land use scenarios at
29 this site due to a single historically detected elevated concentration above the CNC sitewide
30 reference concentration at E596SB006. This elevated detection was not confirmed during
31 recent re-sampling. If the historic elevated detection of BEQs at E596SB006 is not
32 considered, BEQs will not be considered a COC in surface soils at this site. No COCs are
33 identified for subsurface soil or groundwater.

TABLE 5-1

Detected Concentrations of Arsenic, BEQs, Methylene Chloride, and Methyl Ethyl Ketone in Soil at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC (HI=0.1)	SSL (DAF=1)	Zone E Background Range of Conc.
Arsenic	Surface Soil					0.43	1	0.95 – 68
	E596SB001	E596SB00101	10/23/1995	7.7	=			
	E596SB002	E596SB00201	10/23/1995	13	=			
	E596SB003	E596SB00301	10/20/1995	5.7	=			
	E596SB004	E596SB00401	10/23/1995	5.1	=			
	E596SB005	E596SB00501	10/20/1995	6.9	=			
	E596SB006	E596SB00601	10/20/1995	155	=			
	E596SB007	E596SB00701	10/23/1995	7.2	=			
	E596SB009	E596SB00901	10/30/1995	8	=			
	E596SB010	E596SB01001	10/30/1995	10.1	=			
	E596SB011	E596SB01101	10/23/1995	10.3	=			
	E596SB012	E596SB01201	10/30/1995	7.1	=			
	E596SB013	E596SB01301	06/04/1996	14.2	=			
	Subsurface Soil					0.43	1	0.83 – 26
	E596SB001	E596SB00102	10/23/1995	6.5	=			
	E596SB002	E596SB00202	10/23/1995	3.3	=			
	E596SB003	E596SB00302	10/20/1995	19.6	=			
	E596SB004	E596SB00402	10/23/1995	3.2	=			
	E596SB005	E596SB00502	10/20/1995	9.9	=			
	E596SB006	E596SB00602	10/20/1995	19	=			
	E596SB007	E596SB00702	10/23/1995	22	=			
	E596SB009	E596SB00902	10/30/1995	15.1	=			
	E596SB010	E596SB01002	10/30/1995	38.7	=			
	E596SB011	E596SB01102	10/23/1995	21	=			
	E596SB012	E596SB01202	10/30/1995	3.9	=			
	E596SB013	E596SB01302	06/04/1996	6.8	=			
BEQs	Surface Soil					NA	NA	1.304
	E596SB001	E596SB00101	10/23/1995	866.625	U			

TABLE 5-1

Detected Concentrations of Arsenic, BEQs, Methylene Chloride, and Methyl Ethyl Ketone in Soil at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC (HI=0.1)	SSL (DAF=1)	Zone E Background Range of Conc.
BEQs	Surface Soil					NA	NA	1.304
	E596SB002	E596SB00201	10/23/1995	802.24	=			
	E596SB003	E596SB00301	10/20/1995	540.73	=			
	E596SB004	E596SB00401	10/23/1995	588.92	=			
	E596SB005	E596SB00501	10/20/1995	494.26	=			
	E596SB006	E596SB00601	10/20/1995	89862	=			
	E596SB007	E596SB00701	10/23/1995	961.41	=			
	E596SB009	E596SB00901	10/30/1995	551.09	=			
	E596SB010	E596SB01001	10/30/1995	970.62	U			
	E596SB011	E596SB01101	10/23/1995	889.735	U			
	E596SB012	E596SB01201	10/30/1995	1,109.28	U			
	E596SB013	E596SB01301	06/04/1996	4,452.2	=			
	Subsurface Soil					NA	NA	1.4
	E596SB001	E596SB00102	10/23/1995	982.175	U			
	E596SB002	E596SB00202	10/23/1995	1,063.06	U			
	E596SB003	E596SB00302	10/20/1995	1,386.6	U			
	E596SB004	E596SB00402	10/23/1995	924.4	U			
	E596SB005	E596SB00502	10/20/1995	1,155.5	U			
	E596SB006	E596SB00602	10/20/1995	2,097.8	=			
	E596SB007	E596SB00702	10/23/1995	1848.8	U			
	E596SB009	E596SB00902	10/30/1995	1,155.5	U			
	E596SB010	E596SB01002	10/30/1995	1,617.7	U			
	E596SB011	E596SB01102	10/23/1995	1,271.05	U			
	E596SB012	E596SB01202	10/30/1995	970.62	U			
	E596SB013	E596SB01302	06/04/1996	314.27	5			
Methylene Chloride	Surface Soil					85	0.001	NA
	E596SB001	E596SB00101	10/23/1995	0.027	U			
	E596SB003	E596SB00301	10/20/1995	0.048	U			

TABLE 5-1

Detected Concentrations of Arsenic, BEQs, Methylene Chloride, and Methyl Ethyl Ketone in Soil at AOC 596

RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC (HI=0.1)	SSL (DAF=1)	Zone E Background Range of Conc.
Methylene Chloride	Surface Soil					85	0.001	NA
	E596SB004	E596SB00401	10/23/1995	0.034	UJ			
	E596SB005	E596SB00501	10/20/1995	0.006	U			
	E596SB006	E596SB00601	10/20/1995	0.002	J			
	E596SB007	E596SB00701	10/23/1995	0.01	U			
	E596SB009	E596SB00901	10/30/1995	0.006	U			
	E596SB010	E596SB01001	10/30/1995	0.006	U			
	E596SB011	E596SB01101	10/23/1995	0.008	U			
	E596SB012	E596SB01201	10/30/1995	0.007	U			
	Subsurface Soil					85	0.001	NA
	E596SB001	E596SB00102	10/23/1995	0.006	U			
	E596SB002	E596SB00202	10/23/1995	0.009	U			
	E596SB003	E596SB00302	10/20/1995	0.089	U			
	E596SB004	E596SB00402	10/23/1995	0.028	U			
	E596SB005	E596SB00502	10/20/1995	0.008	U			
	E596SB006	E596SB00602	10/20/1995	0.02	U			
	E596SB007	E596SB00702	10/23/1995	0.016	U			
	E596SB009	E596SB00902	10/30/1995	0.008	U			
	E596SB010	E596SB01002	10/30/1995	0.011	U			
	E596SB011	E596SB01102	10/23/1995	0.009	U			
	E596SB012	E596SB01202	10/30/1995	0.006	U			
	E596SB013	E596SB01302	06/04/1996	0.007	U			
Methyl Ethyl Ketone	Surface Soil					4,700	0.4 ^a	NA
	E596SB001	E596SB00101	10/23/1995	0.011	U			
	E596SB003	E596SB00301	10/20/1995	0.012	U			
	E596SB004	E596SB00401	10/23/1995	0.011	UJ			
	E596SB005	E596SB00501	10/20/1995	0.012	U			
	E596SB006	E596SB00601	10/20/1995	0.014	U			

TABLE 5-1

Detected Concentrations of Arsenic, BEQs, Methylene Chloride, and Methyl Ethyl Ketone in Soil at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC (HI=0.1)	SSL (DAF=1)	Zone E Background Range of Conc.
Methyl Ethyl Ketone	Surface Soil					4,700	0.4 ^a	NA
	E596SB007	E596SB00701	10/23/1995	0.013	U			
	E596SB009	E596SB00901	10/30/1995	0.01	J			
	E596SB010	E596SB01001	10/30/1995	0.013	U			
	E596SB011	E596SB01101	10/23/1995	0.012	U			
	E596SB012	E596SB01201	10/30/1995	0.006	J			
	Subsurface Soil					4,700	0.4 ^a	NA
	E596SB001	E596SB00102	10/23/1995	0.013	U			
	E596SB002	E596SB00202	10/23/1995	0.007	J			
	E596SB003	E596SB00302	10/20/1995	0.019	J			
	E596SB004	E596SB00402	10/23/1995	0.012	U			
	E596SB005	E596SB00502	10/20/1995	0.016	U			
	E596SB006	E596SB00602	10/20/1995	0.014	U			
	E596SB007	E596SB00702	10/23/1995	0.048	=			
	E596SB009	E596SB00902	10/30/1995	0.016	U			
	E596SB010	E596SB01002	10/30/1995	0.022	U			
	E596SB011	E596SB01102	10/23/1995	0.017	U			
	E596SB012	E596SB01202	10/30/1995	0.013	U			
	E596SB013	E596SB01302	06/04/1996	0.012	U			

All values are presented in units of milligrams per kilogram (mg/kg).

Concentrations in bold and outlined within the table indicate an exceedance of screening criteria.

^a No SSL with a DAF=1 exists for methyl ethyl ketone. The EPA Region III SSL was used.

J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quantification limit.

NA Not Applicable

TABLE 5-2

Detected Concentrations of Antimony, Arsenic, Lead, and Thallium in Groundwater at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	EPA Region III Tap Water RBC	MCL	Zone E Background Range of Conc.
Antimony	Shallow Groundwater					1.5	6	2 – 5
	E596GW001	E596GW00101	03/21/1996	4	U			
	E596GW001	E596GW00102	07/01/1996	13	U			
	E596GW001	E596GW00103	10/30/1996	2.1	U			
	E596GW001	E596GW00104	01/10/1997	2.1	U			
	E596GW002	E596GW00201	03/21/1996	4	U			
	E596GW002	E596GW00202	07/02/1996	13	U			
	E596GW002	E596GW00203	10/30/1996	2.1	U			
	E596GW002	E596GW00204	01/10/1997	2.1	U			
	E596GW003	E596GW00301	03/22/1996	4	U			
	E596GW003	E596GW00302	07/08/1996	13	U			
	E596GW003	E596GW00303	10/30/1996	2.1	U			
	E596GW003	E596GW00304	01/13/1997	2.1	U			
	E596GW004	E596GW00401	03/22/1996	4	U			
	E596GW004	E596GW00402	07/02/1996	13	U			
	E596GW004	E596GW00403	10/31/1996	4.2	U			
	E596GW004	E596GW00404	01/13/1997	2.1	U			
	Deep Groundwater					1.5	6	3 – 7
	E596GW01D	E596GW01D01	04/10/1996	4	U			
	E596GW01D	E596GW01D02	07/01/1996	13	U			
	E596GW01D	E596GW01D03	10/30/1996	2.1	U			
	E596GW01D	E596GW01D04	01/10/1997	2.1	U			
	E596GW04D	E596GW04D01	04/11/1996	4	U			
	E596GW04D	E596GW04D02	07/09/1996	2.1	U			
	E596GW04D	E596GW04D03	10/31/1996	2.1	U			
	E596GW04D	E596GW04D04	01/13/1997	2.1	U			
Arsenic	Shallow Groundwater					0.045	50	3 – 316
	E596GW001	E596GW00101	03/21/1996	11	=			

TABLE 5-2

Detected Concentrations of Antimony, Arsenic, Lead, and Thallium in Groundwater at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	EPA Region III Tap Water RBC	MCL	Zone E Background Range of Conc.
Arsenic	Shallow Groundwater					0.045	50	3 – 316
	E596GW001	E596GW00102	07/01/1996	17.8	=			
	E596GW001	E596GW00103	10/30/1996	12.4	=			
	E596GW001	E596GW00104	01/10/1997	15	=			
	E596GW002	E596GW00201	03/21/1996	5	U			
	E596GW002	E596GW00202	07/02/1996	16.2	=			
	E596GW002	E596GW00203	10/30/1996	3.2	J			
	E596GW002	E596GW00204	01/10/1997	2.8	J			
	E596GW003	E596GW00301	03/22/1996	7.6	J			
	E596GW003	E596GW00302	07/08/1996	24.9	=			
	E596GW003	E596GW00303	10/30/1996	28.5	=			
	E596GW003	E596GW00304	01/13/1997	44.6	=			
	E596GW004	E596GW00401	03/22/1996	5	U			
	E596GW004	E596GW00402	07/02/1996	3.3	U			
	E596GW004	E596GW00403	10/31/1996	3.6	U			
	E596GW004	E596GW00404	01/13/1997	2.5	U			
	Deep Groundwater					0.045	50	3 – 132
	E596GW01D	E596GW01D01	04/10/1996	43.8	=			
	E596GW01D	E596GW01D02	07/01/1996	27.9	=			
	E596GW01D	E596GW01D03	10/30/1996	48.4	=			
	E596GW01D	E596GW01D04	01/10/1997	35.9	=			
	E596GW04D	E596GW04D01	04/11/1996	13.5	=			
	E596GW04D	E596GW04D02	07/09/1996	17.5	=			
	E596GW04D	E596GW04D03	10/31/1996	6.3	U			
	E596GW04D	E596GW04D04	01/13/1997	4.1	J			
Lead	Shallow Groundwater					15	15	2 – 4
	E596GW001	E596GW00101	03/21/1996	3	U			
	E596GW001	E596GW00102	07/01/1996	9	U			

TABLE 5-2

Detected Concentrations of Antimony, Arsenic, Lead, and Thallium in Groundwater at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	EPA Region III Tap Water RBC	MCL	Zone E Background Range of Conc.
Lead	Shallow Groundwater					15	15	2 – 4
	E596GW001	E596GW00103	10/30/1996	1.7	U			
	E596GW001	E596GW00104	01/10/1997	1.7	UJ			
	E596GW002	E596GW00201	03/21/1996	3.	U			
	E596GW002	E596GW00202	07/02/1996	28.1	=			
	E596GW002	E596GW00203	10/30/1996	1.7	U			
	E596GW002	E596GW00204	01/10/1997	1.7	UJ			
	E596GW003	E596GW00301	03/22/1996	3	U			
	E596GW003	E596GW00302	07/08/1996	1.4	U			
	E596GW003	E596GW00303	10/30/1996	1.7	U			
	E596GW003	E596GW00304	01/13/1997	1.7	UJ			
	E596GW004	E596GW00401	03/22/1996	3	U			
	E596GW004	E596GW00402	07/02/1996	1.4	U			
	E596GW004	E596GW00403	10/31/1996	1.7	U			
	E596GW004	E596GW00404	01/13/1997	1.7	UJ			
	Deep Groundwater					15	15	2 – 3
	E596GW01D	E596GW01D01	04/10/1996	3	U			
	E596GW01D	E596GW01D02	07/01/1996	1.4	U			
	E596GW01D	E596GW01D03	10/30/1996	1.7	U			
	E596GW01D	E596GW01D04	01/10/1997	1.7	UJ			
	E596GW04D	E596GW04D01	04/11/1996	3	U			
	E596GW04D	E596GW04D02	07/09/1996	1.8	J			
	E596GW04D	E596GW04D03	10/31/1996	1.7	U			
	E596GW04D	E596GW04D04	01/13/1997	1.7	UJ			
Thallium	Shallow Groundwater					0.26	2	3.2 - 5.8
	E596GW001	596GW00101	03/21/1996	5	U			
	E596GW001	596GW00102	07/01/1996	3.4	U			
	E596GW001	596GW00103	10/30/1996	4.9	U			

TABLE 5-2

Detected Concentrations of Antimony, Arsenic, Lead, and Thallium in Groundwater at AOC 596
RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration ($\mu\text{g/L}$)	Qualifier	EPA Region III Tap Water RBC	MCL	Zone E Background Range of Conc.
Thallium	Shallow Groundwater					0.26	2	3.2 - 5.8
	E596GW001	596GW00104	01/10/1997	2.7	UJ			
	E596GW002	596GW00201	03/21/1996	5	U			
	E596GW002	596GW00202	07/02/1996	3.4	U			
	E596GW002	596GW00203	10/30/1996	5.3	U			
	E596GW002	596GW00204	01/10/1997	2.7	UJ			
	E596GW003	596GW00301	03/22/1996	5	U			
	E596GW003	596GW00302	07/08/1996	3.4	U			
	E596GW003	596GW00303	10/30/1996	6	U			
	E596GW003	596GW00304	01/13/1997	6.7	J			
	E596GW004	596GW00401	03/22/1996	5	U			
	E596GW004	596GW00402	07/02/1996	3.4	U			
	E596GW004	596GW00403	10/31/1996	2.7	U			
	E596GW004	596GW00404	01/13/1997	2.7	UJ			
Thallium	Deep Groundwater					0.26	2	2.7 - 7.4
	E596GW01D	596GW01D01	04/10/1996	5	U			
	E596GW01D	596GW01D02	07/01/1996	3.4	U			
	E596GW01D	596GW01D03	10/30/1996	3.3	U			
	E596GW01D	596GW01D04	01/10/1997	2.7	UJ			
	E596GW04D	596GW04D01	04/11/1996	5	U			
	E596GW04D	596GW04D02	07/09/1996	2.7	UJ			
	E596GW04D	596GW04D03	10/31/1996	2.8	U			
	E596GW04D	596GW04D04	01/13/1997	7	J			

All values are presented in units of micrograms per liter ($\mu\text{g/L}$).

Concentrations in bold and outlined within the table indicate an exceedance of screening criteria.

J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quantification limit.

NA Not Applicable

TABLE 5-3

UCL₉₅ Calculations for Arsenic in Surface Soil at AOC 596 (Including and Excluding E596SB006 Sample Result)
 RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Site: AOC 596		Site: AOC 596	
Media: Surface Soil		Media: Surface Soil	
Units: mg/kg		Units: mg/kg	
Chemical: Arsenic		Chemical: Arsenic	
CASRN:		CASRN:	
Note: Elevated arsenic hit of 155 mg/kg at E596SB006 included		Note: Elevated arsenic hit of 155 mg/kg at E596SB006 excluded	
STATISTICS		STATISTICS	
N	12	N	11
Detects	12	Detects	11
FOD	100%	FOD	100%
Mean of Detect	20.858	Mean of Detect	8.664
Min of Detect	5.1000	Min of Detect	5.1000
Max of Detect	155.00	Max of Detect	14.20
Best Estimate of Mean (arithmetic)	39.5	Best Estimate of Mean (arithmetic)	8.7
Best Estimate of Mean (geometric)	10.5	Best Estimate of Mean (geometric)	8.3
Nondetects at 1/2 DL	YES	Nondetects at 1/2 DL	YES
95% UPPER CONFIDENCE LIMITS FOR MEAN		95% UPPER CONFIDENCE LIMITS FOR MEAN	
UCL95 Normal	42.8	UCL95 Normal	10.3
t-statistic	1.80	t-statistic	1.81
UCL95 Lognormal	33.3	UCL95 Lognormal	10.6
H-statistic	2.74	H-statistic	1.95
UCL95 Nonparametric	5.7	UCL95 Nonparametric	5.7
UCL95 Bootstrap	39.49	UCL95 Bootstrap	10
95% UPPER TOLERANCE INTERVAL		95% UPPER TOLERANCE INTERVAL	
UTL95 Normal	99.99622354	UTL95 Normal	14.17311725
coverage	95%	coverage	95%
UTL95 Lognormal	56.75503959	UTL95 Lognormal	15.19153139
coverage	95%	coverage	95%
UTL95 Nonparametric	155.00	UTL95 Nonparametric	14.20
coverage	92%	coverage	92%
DISTRIBUTION TESTING		DISTRIBUTION TESTING	
Population is best described as: NONPARAMETRIC		Population is best described as: LOGNORMAL	
W _{normal}	0.385	W _{normal}	0.907
W _{log}	0.652	W _{log}	0.953
W _{α = 0.05}	0.859	W _{α = 0.05}	0.850

Table Notes:

1. If population does not fit normal or lognormal distribution, check Q-Q plots and W-test values. The population may be close enough to one of those distributions to subjectively select a normal or lognormal distribution.
2. For site data, if the selected UCL₉₅ exceeds the Max Detect, the Max Detect should be chosen as the EPC.
3. Lognormal UCL or UTL values calculated for less than 30 samples may be widely inflated.
4. If there is >90% nondetection, it is generally impossible to calculate a UTL or UCL with any level of confidence.

TABLE 5-4
 UCL₉₅ Calculations for BEQs in Surface Soil at AOC 596 (Including and Excluding E596SB006 Sample Result)
 RFI Report Addendum and CMS Work Plan, AOC 596, Zone E, Charleston Naval Complex

Site:	AOC 596
Media:	Surface Soil
Units:	ug/kg
Chemical:	BEQs
CASRN:	Surface Soil
Note: Elevated BEQ hit of 89.86 mg/kg at E596SB006 Included	
STATISTICS	
N	13
Detects	8
FOD	62%
Mean of Detect	12281.606
Min of Detect	494.2600
Max of Detect	89862.00
Best Estimate of Mean (arithmetic)	7709.6
Best Estimate of Mean (geometric)	819.3
Nondetects at 1/2 DL	YES
95% UPPER CONFIDENCE LIMITS FOR MEAN	
UCL95 Normal	19921.4
t-statistic	1.78
UCL95 Lognormal	20817.4
H-statistic	3.71
UCL95 Nonparametric	444.8675
UCL95 Bootstrap	18457
95% UPPER TOLERANCE INTERVAL	
UTL95 Normal	53401.87398
coverage	95%
UTL95 Lognormal	18636.25215
coverage	95%
UTL95 Nonparametric	89862.00
coverage	93%
DISTRIBUTION TESTING	
Population is best described as:	NONPARAMETRIC
W _{normal}	0.337
W _{log}	0.742
W _{α = 0.05}	0.866

Site:	AOC 596
Media:	Surface Soil
Units:	ug/kg
Chemical:	BEQs
CASRN:	
Note: Elevated BEQ hit of 89.86 mg/kg at E596SB006 excluded	
STATISTICS	
N	13
Detects	7
FOD	54%
Mean of Detect	1198.7
Min of Detect	494.3
Max of Detect	4452.2
Best Estimate of Mean (arithmetic)	1308.5
Best Estimate of Mean (geometric)	463.1
Nondetects at 1/2 DL	YES
95% UPPER CONFIDENCE LIMITS FOR MEAN	
UCL95 Normal	1356.9
t-statistic	1.78
UCL95 Lognormal	2191.0
H-statistic	2.80
UCL95 Nonparametric	433.3
UCL95 Bootstrap	1308.5
95% UPPER TOLERANCE INTERVAL	
UTL95 Normal	2880.17
coverage	95%
UTL95 Lognormal	3750.1
coverage	95%
UTL95 Nonparametric	4452.2
coverage	93%
DISTRIBUTION TESTING	
Population is best described as:	NONPARAMETRIC
W _{normal}	0.511
W _{log}	0.816
W _{α = 0.05}	0.866

Table Notes:

1. If population does not fit normal or lognormal distribution, check Q-Q plots and W-test values. The population may be close enough to one of those distributions to subjectively select a normal or lognormal distribution.
2. For site data, if the selected UCL₉₅ exceeds the Max Detect, the Max Detect should be chosen as the EPC.
3. Lognormal UCL or UTL values calculated for less than 30 samples may be widely inflated.
4. If there is >90% nondetection, it is generally impossible to calculate a UTL or UCL with any level of confidence.

6.0 Summary of Information Related to Site Closeout Issues

6.1 RFI Status

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) addressed SWMUs/AOCs within Zone E of the CNC, including AOC 596.

In accordance with the RFI completion process, if a determination of No Further Investigation (NFI) is made upon completion of the RFI, then a site may proceed to either NFA status or to a CMS. The RFI for AOC 596 identified COCs for surface soils and deep groundwater. Based on the discussion presented in Section 5.0, arsenic and BEQs in surface soil are identified as COCs for the unrestricted land use scenario at AOC 596.

The remaining subsections address the issues that the BCT agreed to evaluate prior to site closeout.

6.2 Presence of Inorganics in Groundwater

For the purpose of site closeout documentation, the inorganics in groundwater issue refers to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and antimony) in groundwater at concentrations above the applicable MCL, preceded or followed by detections of these same metals below the MCL or below the practicable quantitation limit.

There were no detections of antimony in shallow or deep wells above the laboratory detection limits. There were no detections of arsenic above the State of South Carolina MCL in samples from the shallow or deep groundwater monitoring wells. Intermittent detections of thallium in shallow and deep groundwater at the site above the MCL do not point to a site-specific source, but can be attributed to natural occurrence. Table 5-2 shows thallium concentrations from the RFI groundwater sampling at AOC 596. Further evaluation of this issue is not warranted.

6.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC

There are no data suggesting that there was an impact to the sanitary sewers from this site. Therefore, further evaluation of this issue is not warranted.

6.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC

A storm sewer drop inlet exists at the southeast corner of the AOC 596. The storm sewer line in this area was not investigated as part of AOC 699. There are no data indicating that any impact to the storm sewer system has occurred from site-related operations. Therefore, further evaluation of this issue is not warranted.

6.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC

The nearest railroad line to AOC 596 runs adjacent to the north side of Building 101. There is no known linkage between AOC 596 and the investigated railroad lines of AOC 504, so further evaluation of this issue is not warranted. However, it is possible that the current and former railroads at the site resulted in elevated detections of some chemicals at this site.

6.6 Potential Migration Pathways to Surface Water Bodies at the CNC

The nearest surface water body to AOC 596 is the Cooper River, which lies approximately 350 feet east of the site. The only potential migration pathway from the site to surface water is via overland flow via stormwater runoff. Runoff directed to the storm sewer system, which discharges to the Cooper River, does not contact the surface soil. Since the COC detections at the site are under concrete and asphalt pavement, no further evaluation of a potential pathway for contaminant migration via stormwater runoff is warranted.

6.7 Potential Contamination in Oil/Water Separators (OWSs)

There are no OWSs associated with AOCs 596. In addition, there is no reference to an OWS at the site in the *Oil Water Separator Data* report, Department of the Navy, September 2000. Therefore, further evaluation of this issue is not warranted.

1 **6.8 Land Use Controls (LUCs)**

- 2 The BCT has agreed that land use controls will be applied across all of Zone E at the CNC.
- 3 These LUCs are expected to include, at a minimum, restrictions for future land use to non-
- 4 residential use only. These LUCs will apply at AOC 596 due to its location within Zone E.
- 5 In addition, the applicability of LUCs will be assessed as part of the CMS phase for this site,
- 6 which will address arsenic and BEQs in surface soil.

1 **7.0 Recommendations**

2 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified arsenic and BEQs as COCs in
3 surface soil under the unrestricted land use scenario for AOC 596. No COCs were identified
4 in the RFI report for subsurface soil. This RFI report addendum confirmed these findings. If
5 the elevated BEQ detections at E596SB006, which were not confirmed during recent
6 resampling, are replaced by the data from the recent sampling, BEQ levels in surface soils
7 will be representative of background levels and will not be considered a surface soil COC at
8 this site. However, BEQs have been retained as a COC in surface soils as a conservative
9 measure.

10 Arsenic and lead were identified in the RFI report as COCs for shallow groundwater, and
11 arsenic and thallium were identified as COCs for deep groundwater. Based on an
12 evaluation of the data against current screening criteria adopted by the BCT, as well as the
13 site conditions as discussed herein, no groundwater COCs are identified at this site.

14 AOC 596 is recommended for a CMS to address arsenic and BEQs in surface soil. Because
15 this site is within Zone E, LUCs that are applicable across Zone E will also apply at this
16 location and will be further considered during the CMS. A CMS work plan is provided in
17 Section 8.0 of this report.

1 **8.0 CMS Work Plan for AOC 596**

2 Arsenic and BEQs were identified as COCs in surface soil for the unrestricted land use
3 scenario. BEQs were identified as a COC in surface soil for the industrial land use scenario.
4 Because there is no exposed surface soil at the site with BEQ- or arsenic-containing soils,
5 there is currently no unacceptable exposure or risk from these COCs; however, it is feasible
6 that in the future, should site conditions change, some exposure could occur. Therefore, a
7 CMS should be conducted to evaluate potential corrective measures and identify an
8 appropriate remedy for the site.

9 This section presents a focused CMS work plan. Media cleanup standards (MCSs) are
10 identified for COCs and potential remedies that should be evaluated are also presented.

11 **8.1 Remedial Action Objectives**

12 Remedial action objectives (RAOs) are medium-specific goals that the remedial actions are
13 designed to accomplish in order to protect human health and the environment by
14 preventing or reducing exposures under current and future land use conditions. The RAOs
15 identified for the surface soil at AOC 596 are being chosen to prevent ingestion and
16 direct/dermal contact with surface soil containing COCs at unacceptable levels. No
17 remedial actions are required for subsurface soil or groundwater at AOC 596.

18 **8.2 Remedial Goal Options and Media Cleanup Standards**

19 Throughout the process of remediating a hazardous waste site, a risk manager uses a
20 progression of increasingly acceptable site-specific media levels in considering remedial
21 alternatives. Under the RCRA program, remedial goal options (RGOs) and MCSs are
22 developed at the end of the risk assessment in the RFI/Remedial Investigation (RI)
23 programs, before completion of the CMS.

24 RGOs can be based on a variety of criteria, such as specific incremental lifetime cancer risk
25 (ILCR) levels (e.g., 1E-04, 1E-05, or 1E-06), HI levels (e.g., 0.1, 1.0, 3.0), or site background
26 concentrations. For a particular RGO, specific MCSs can be determined as target
27 concentration values. Achieving these MCSs is accepted as demonstrating that RGOs and
28 RAOs have been achieved. Achieving these goals should promote the protection of human
29 health and the environment, while achieving compliance with applicable state and federal
30 standards.

The exposure medium of concern for AOC 596 is surface soil impacted by arsenic and BEQs. Because AOC 596 is located within a highly developed area of the CNC and there are no surface water bodies in the immediate vicinity of the site, ecological exposures were not considered applicable for evaluation.

The general vicinity around AOC 596 within Zone E has elevated concentrations of arsenic and BEQs, making it unfit for future unrestricted (i.e., residential) land use. For BEQs, the target MCS for surface soil should be the sitewide reference concentration of 1.304 mg/kg, which was developed by the BCT. For arsenic within Zone E, the MCS is the background arsenic concentration. An MCS will be met if the site statistical estimates of concentrations are similar to the background statistical estimates. For point comparisons between site and background levels, site concentration ranges may be compared with the ranges of background concentrations. The EPA Region IV residential land use value for arsenic in soil of 20 mg/kg, or a sitewide average similar to that in Zone E, are potential practical MCSs for this area. Other potential RGOs, such as the 1E-06 ILCR, were considered but regarded as not applicable because the site background concentrations of arsenic and BEQs are significantly greater than this level. The background levels of these chemicals preclude this area from suitability for future residential land use.

8.3 Potential Remedies to Evaluate

Because of the small size of this site and the relatively small quantity of impacted surface soil, the list of practicable remedial alternatives for this site is limited. The two presumptive remedies that will be evaluated as part of the CMS include:

- Soil excavation and offsite disposal
- Land use controls

8.4 Focused CMS Approach

The focused CMS will consist of the following tasks that will be performed in the order presented below:

1. The corrective measure alternatives described above will be screened using several criteria and decision factors.
2. A preferred corrective measure alternative will be selected.
3. The CMS and preferred corrective measure alternative will be documented in the CMS report.

8.5 Approach to Evaluating Corrective Measure Alternatives

According to the RCRA permit issued by SCDHEC (SCDHEC, 1998), the alternatives will be evaluated with the following five standards:

1. Protecting human health and the environment.
2. Attaining media cleanup standards (RGOs).
3. Controlling the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Complying with applicable standards for the management of wastes generated by remedial activities.
5. Other factors include (a) long-term reliability and effectiveness; (b) reduction in toxicity, mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and (e) cost.

Each of the five criteria is defined in more detail below:

- 1. Protecting human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this criterion may or may not be independent of its ability to achieve the other four standards. For example, an alternative may be protective of human health, but may not be able to attain the MCSs if the MCSs are not directly tied to protecting human health.
- 2. Attaining media cleanup standards (RGOs).** The alternatives will be evaluated on the basis of their ability to achieve the RGOs defined in this CMS Work Plan. Another aspect of this criterion is the timeframe to achieve the RGOs. Estimates of the timeframe for the alternatives to achieve RGOs will be provided.
- 3. Controlling the source of releases.** This criterion deals with the control of releases of contamination from the source (the area in which the contamination originated).
- 4. Complying with applicable standards for management of wastes.** This criterion deals with the management of wastes derived from implementing the alternatives, for example, treatment or disposal of excavated material. The soil removal alternative will be designed to comply with all applicable standards for management of remediation wastes. Consequently, this criterion will not be explicitly included in the detailed evaluation presented in the CMS but will be part of a work plan specific to the removal action should a removal action become the chosen alternative.

5. **Other factors.** Five other factors are to be considered if an alternative is found to meet the four criteria described above. These other factors are as follows:

a. Long-term reliability and effectiveness

The two alternatives will be evaluated on the basis of their reliability, and the potential impact should the chosen alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failure and the consequences of that failure.

b. Reduction in the toxicity, mobility, or volume of wastes

Alternatives with technologies that reduce the toxicity, mobility, or volume of the contamination will be generally favored over those that do not. Consequently, a qualitative assessment of this factor will be performed for each alternative.

c. Short-term effectiveness

Alternatives will be evaluated on the basis of the risk they create during the implementation of the remedy. Factors that may be considered include fire, explosion, and exposure of workers to hazardous substances.

d. Implementability

The alternatives will be evaluated for their implementability by considering any difficulties associated with conducting the alternatives (such as the construction disturbances they may create), operation of the alternatives, and the availability of equipment and resources to implement the technologies comprising the alternatives.

e. Cost

A net present value of each alternative will be developed. These cost estimates will be used for the relative evaluation of the alternatives, not to bid or budget the work. The estimates will be based on information available at the time of the CMS and on a conceptual design of the alternative. They will be "order-of-magnitude" estimates with a generally expected accuracy of -50 percent to +50 percent for the scope of action described for each alternative. The estimates will be categorized into capital costs and operations and maintenance costs for each alternative.

In addition to the criteria described above, the alternatives will be evaluated for their ability to achieve all contractual obligations of CH2M-Jones and the Navy.

1 **8.6 Focused CMS Report**

2 A focused CMS Report will be prepared to present the identification, development, and
3 evaluation of potential corrective measures for AOC 596. A proposed outline of the report,
4 as shown in Table 8-1, provides an example of the report format and content.

TABLE 8-1
 Outline of Focused CMS Report for AOC 596
RFI Report Addendum & CMS Work Plan, AOC 596 Zone F, Charleston Naval Complex

Section No.	Section Title
1.0	Introduction
1.1	Corrective Measures Study Purpose and Scope
1.2	Report Organization
1.3	Background Information
1.3.1	Facility Description
1.3.2	Site History and Background
1.3.2.1	Nature and Extent of Contamination
1.3.2.2	Summary of Risk Assessment
2.0	Remedial Goal Objectives
3.0	Detailed Analysis of Focused Alternatives
3.1	Approach
3.2	Evaluation Criteria
3.3	Description of Alternatives
3.3.1	Alternative 1: Soil removal and Offsite Disposal
3.3.2	Alternative 2: Land Use Controls
3.4	Detailed Analysis of Alternatives
3.4.1	Analysis of Alternative 1
3.4.2	Analysis of Alternative 2
3.5	Comparative Analysis of Alternatives
4.0	Recommended Remedial Alternative
5.0	References
Appendix A	Corrective Measure Alternative Cost Estimates^b
List of Tables	
List of Figures	

^a Additional alternatives will be analyzed as found necessary.

^b Additional appendices will be added, if necessary.

9.0 References

- EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston*. 1997.
- EnSafe Inc./ Allen & Hoshall. *Final RCRA Facility Assessment, NAVBASE Charleston*. July 1995.
- EnSafe Inc./ Allen & Hoshall. *Final Zone E RFI Work Plan, Revision 1, NAVBASE Charleston*. June 1995.
- CH2M-Jones. *Technical Memorandum: A Summary of Inorganic Chemical Concentrations in Background Soil and Groundwater at the CNC*. 2001.
- CH2M-Jones. *Technical Memorandum: Results from Additional Background Sampling of the CNC Railroad Lines and Naval Annex (Zone K)*. CNC. August 2001.
- South Carolina Department of Health and Environmental Control, Final RCRA Part B Permit No.
- U.S. Environmental Protection Agency, US EPA Region 4 Memorandum from Dann Spariosu to Mihir Mehta titled *Remedial Goals for Arsenic in Soil*, March 30, 2001 with attachment of memorandum from Ted Simon to Dann Spariosu titled *Remediation Goals for Arsenic in Soil at DOD Facilities*, dated March 29, 2001.

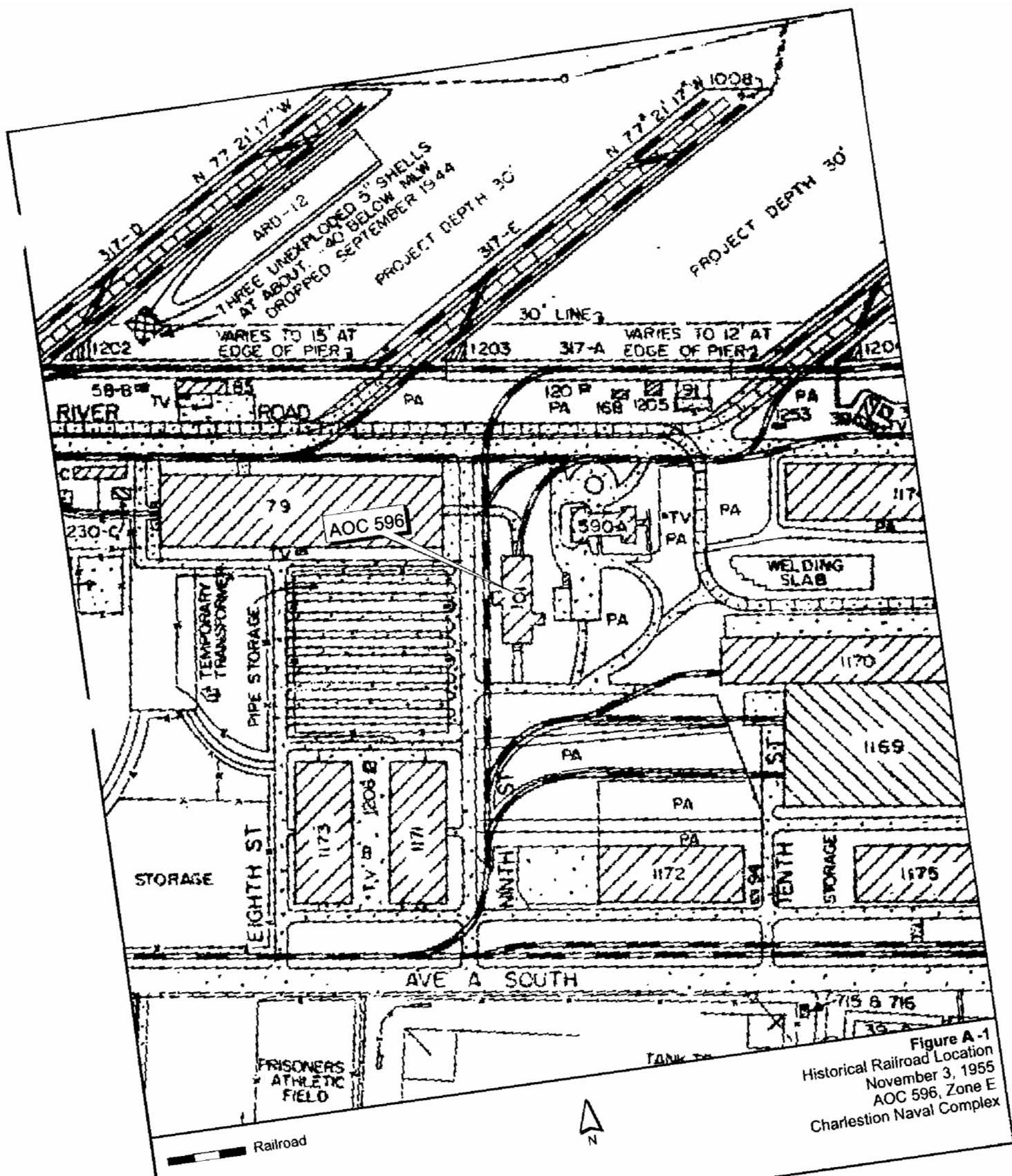


Figure A-1
Historical Railroad Location
November 3, 1955
AOC 596, Zone E
Charleston Naval Complex

Table 10 45 6 1
Chemicals Present in Site Samples
AOC 596 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Conc.	Range of SQL		Screening Concentrations			Units	Number Exceeding					
								Residential RBC	Industrial RBC	Reference		Res.	Ind	Ref			
Carcinogenic PAHs																	
B(a)P Equiv	*	*	8	12	11.11	89862	11997	1733	25	2218	56	88	780	NA	UG/KG	7	2
Benzo(a)anthracene	*	*	7	12	100	70000	10609	750	960	880	7800	NA	UG/KG	2	1		
Benzo(b)fluoranthene	*	*	6	12	91	58000	10230	750	960	880	7800	NA	UG/KG	2	1		
Chrysene			8	12	110	82000	10949	750	960	88000	780000	NA	UG/KG				
Dibenz(a,h)anthracene	*	*	4	12	110	18000	4790	750	960	88	780	NA	UG/KG	4	2		
Indeno(1,2,3-cd)pyrene	*	*	5	12	92	34000	7222	750	960	880	7800	NA	UG/KG	2	1		
Benzo(k)fluoranthene	*		6	12	86	58000	10331	750	960	8800	78000	NA	UG/KG	1			
Benzo(a)pyrene	*	*	7	12	91	55000	8419	750	960	88	780	NA	UG/KG	7	2		
Inorganics																	
Aluminum (Al)			12	12	2070	11300	6015	NA	NA	7800	100000	26600	MG/KG	4			
Antimony (Sb)			10	12	0.48	2.3	1.49	0.48	0.5	3.1	82	1.77	MG/KG			4	
Arsenic (As)	*	*	12	12	5.1	155	20.9	NA	NA	0.43	3.8	23.9	MG/KG	12	12	1	
Barium (Ba)			12	12	18.8	110	41.7	NA	NA	550	14000	130	MG/KG				
Beryllium (Be)			12	12	0.29	0.87	0.48	NA	NA	0.15	1.3	1.7	MG/KG	12			
Cadmium (Cd)			11	12	0.17	1.7	0.68	0.11	0.11	3.9	100	1.5	MG/KG			1	
Calcium (Ca)	N		12	12	2280	179000	37890	NA	NA	NA	NA	NA	MG/KG				
Chromium (Cr)			12	12	10.6	93.1	29.4	NA	NA	39	1000	94.6	MG/KG	2			
Cobalt (Co)			12	12	1.1	97.5	14.2	NA	NA	470	12000	19	MG/KG			3	
Copper (Cu)			12	12	8.7	194	43.8	NA	NA	310	8200	66	MG/KG			1	
Iron (Fe)	N		12	12	4570	19300	9389	NA	NA	NA	NA	NA	MG/KG				
Lead (Pb)			12	12	25.7	317	109	NA	NA	400	1300	265	MG/KG			2	
Magnesium (Mg)	N		12	12	373	5630	1983	NA	NA	NA	NA	NA	MG/KG				
Manganese (Mn)			12	12	37.9	184	84.7	NA	NA	180	4700	302	MG/KG	1			
Mercury (Hg)			12	12	0.04	0.39	0.15	NA	NA	2.3	61	2.6	MG/KG				
Nickel (Ni)			12	12	3.5	20.3	10.6	NA	NA	160	4100	77.1	MG/KG				
Potassium (K)	N		11	12	398	1710	1068	883	883	NA	NA	NA	MG/KG				
Selenium (Se)			9	12	0.59	2	1.10	0.59	0.65	39	1000	1.7	MG/KG			1	
Sodium (Na)	N		10	12	140	1130	371.1	61.2	69.2	NA	NA	NA	MG/KG				
Thallium (Tl)			3	12	0.66	1.1	0.82	0.52	1.8	0.63	16	2.8	MG/KG	3			
Tin (Sn)			8	12	3.7	42.3	11.2	4.2	8	4700	6100	59.4	MG/KG				
Vanadium (V)			12	12	11.8	35.6	20.1	NA	NA	55	1400	94.3	MG/KG				
Zinc (Zn)			12	12	29.4	270	129.7	NA	NA	2300	61000	827	MG/KG				
Pesticides																	
4,4'-DDT			1	1	11	11	11	NA	NA	1900	17000	NA	UG/KG				
Heptachlor			1	1	2	2	2	NA	NA	140	1300	NA	UG/KG				
Semivolatile Organics																	
Acenaphthene			2	12	1100	20000	10550	750	960	470000	12000000	NA	UG/KG				
Anthracene			2	12	210	2500	1355	750	18000	2300000	61000000	NA	UG/KG				
Benzo(g,h,i)perylene			5	12	110	36000	7714	750	960	310000	8200000	NA	UG/KG				
bis(2-Ethylhexyl)phthalate			3	12	86	130	105.3	760	18000	46000	410000	NA	UG/KG				
Butylbenzylphthalate			1	12	210	210	210	750	18000	1600000	41000000	NA	UG/KG				
Dibenzofuran			3	12	120	26000	9003	750	960	31000	820000	NA	UG/KG				
Fluoranthene			5	12	170	220000	46322	750	960	310000	8200000	NA	UG/KG				
Fluorene			3	12	120	18000	6440	750	960	310000	8200000	NA	UG/KG				
2-Methylnaphthalene			2	12	700	11000	5850	750	960	310000	8200000	NA	UG/KG				
Naphthalene			3	12	120	26000	8940	750	960	310000	8200000	NA	UG/KG				
Phenanthrene			6	12	96	220000	38521	750	960	310000	8200000	NA	UG/KG				
Pyrene			8	12	140	160000	21171	750	960	230000	6100000	NA	UG/KG				
Volatile Organics																	
Acetone			1	12	150	150	150	11	130	780000	20000000	NA	UG/KG				
2-Butanone			3	12	6	12	9.33	11	14	4700000	100000000	NA	UG/KG				
Carbon disulfide			3	12	2	4	2.67	6	7	780000	20000000	NA	UG/KG				
Ethylbenzene			1	12	7	7	7	6	7	780000	20000000	NA	UG/KG				
Methylene chloride			1	12	2	2	2	6	48	85000	760000	NA	UG/KG				
Toluene			2	12	1	2	1.5	6	7	1600000	41000000	NA	UG/KG				
Xylene (Total)			1	12	150	150	150	6	7	16000000	100000000	NA	UG/KG				

* - Identified as a residential COPC

** - Identified as an industrial COPC

N - Essential nutrient

MG/KG - milligram per kilogram

UG/KG - microgram per kilogram

SQL - Sample quantitation limit

RBC - Risk-based concentration

NA - Not applicable

Table 10.45.6.4
Chemicals Present in Site Samples
AOC 596 - Groundwater
NAVBASE - Charleston
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Conc.	Range of SQL		Screening Concentrations		Units	Number Exceeding	
								Residential RBC	Reference		RBC	Ref.
Deep Wells												
Inorganics												
Aluminum (Al)	1	2	26.1	26.1	26.1	25	25	3700	319	UG/L		
Arsenic (As)	2	2	13.5	43.8	28.65	NA	NA	0.045	16.4	UG/L	2	1
Barium (Ba)	2	2	32.5	45.1	38.8	NA	NA	260	218	UG/L		
Calcium (Ca)	2	2	174000	177000	175500	NA	NA	NA	NA	UG/L		
Chromium (Cr)	1	2	1.1	1.1	1.1	1	1	18	15.5	UG/L		
Cobalt (Co)	2	2	5.9	10.1	8	NA	NA	220	12.9	UG/L		
Iron (Fe)	2	2	3200	8170	5685	NA	NA	NA	NA	UG/L		
Magnesium (Mg)	2	2	173000	216000	194500	NA	NA	NA	NA	UG/L		
Manganese (Mn)	2	2	356	715	535.5	NA	NA	84	869	UG/L	2	
Mercury (Hg)	2	2	0.2	0.2	0.2	NA	NA	1.1	0.2	UG/L		
Nickel (Ni)	2	2	13.3	15.3	14.3	NA	NA	73	42.2	UG/L		
Potassium (K)	2	2	18100	35800	26950	NA	NA	NA	NA	UG/L		
Sodium (Na)	2	2	1860000	1940000	1900000	NA	NA	NA	NA	UG/L		
Vanadium (V)	2	2	1.1	1.3	1.2	NA	NA	26	5.3	UG/L		
Shallow Wells												
TCDD Equivalents												
Dioxin Equiv.	1	1	0.0087	0.0087	0.0087	NA	NA	0.43	NA	PG/L		
Inorganics												
Aluminum (Al)	4	4	229	535	336	NA	NA	3700	2810	UG/L		
Arsenic (As)	2	4	7.6	11	9.3	5	5	0.045	18.7	UG/L	2	
Chromium (Cr)	1	4	5.3	5.3	5.3	1	1	18	12.3	UG/L		
Iron (Fe)	1	4	11000	11000	11000	1040	6230	NA	NA	UG/L		
Vanadium (V)	2	4	1	3.2	2.1	1	1	26	11.4	UG/L		
Zinc (Zn)	3	4	10.5	14.7	12.03	10	10	1100	27.3	UG/L		

* - Identified as a COPC

N - Essential nutrient

UG/L - micrograms per liter

PG/L - picograms per liter

SQL - Sample quantitation limit

RBC - Risk-based concentration

NA - Not applicable

Analytical Data Summary

11/14/2000 1:39 AM

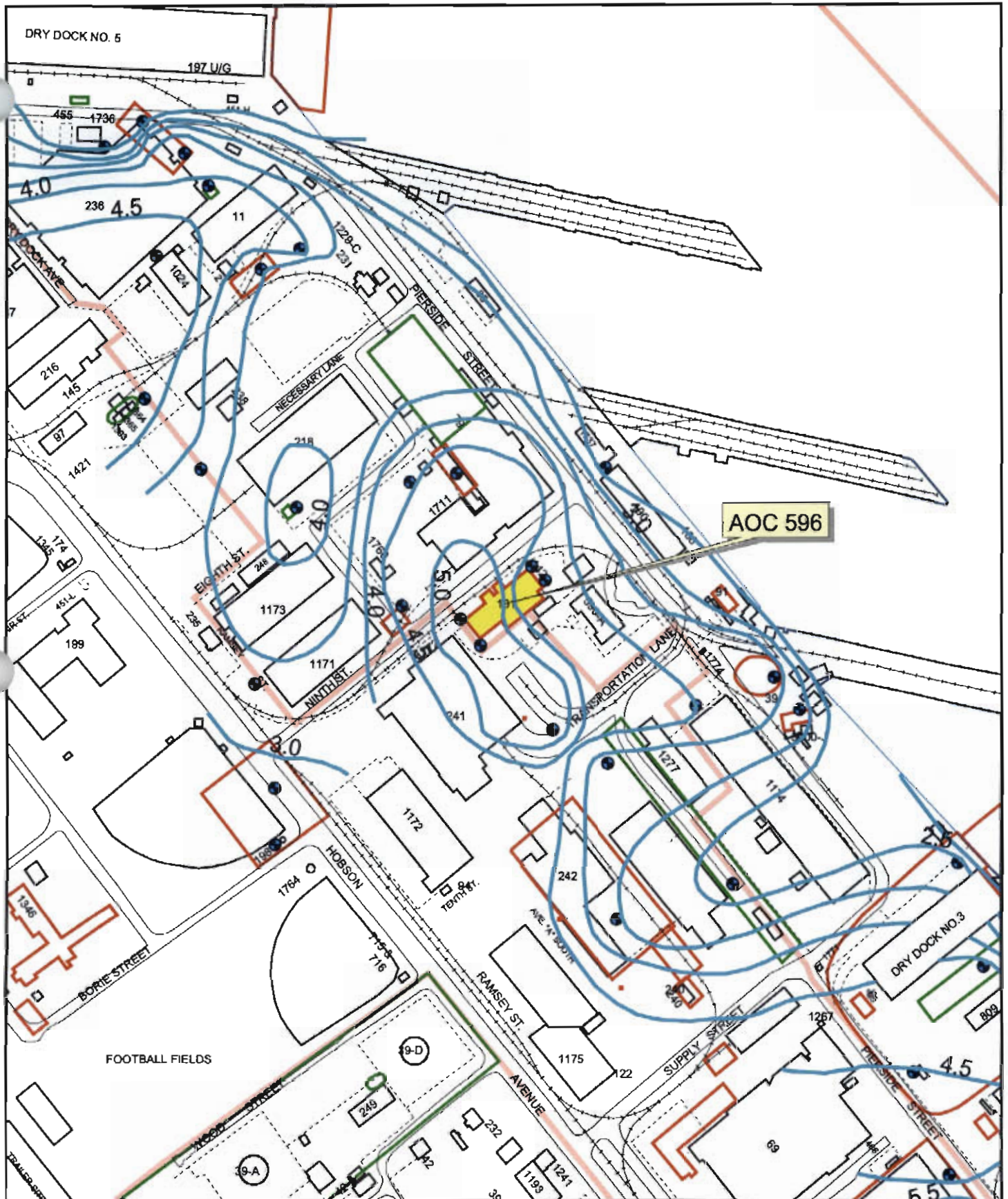
StationID		LABQC		LABQC		LABQC	
SampleID		BLK0381413		BLK0381414		BLK0381423	
DateCollected							
DateExtracted		10/19/1995		10/19/1995		10/19/1995	
DateAnalyzed		10/20/1995		10/20/1995		10/20/1995	
SDGNumber		23814		23814		23814	
Parameter	Units						
Cyanide	ug/L	96.5		96.4		4	U

StationID		LABQC
SampleID		BLK0381426
DateCollected		
DateExtracted		
DateAnalyzed		10/18/1995
SDGNumber		23814
Parameter	Units	
pH	SU	7

Parameter	Units	StationID		SampleID		DateCollected		DateExtracted		DateAnalyzed		SDGNumber	
		LABQC		LABQC		LABQC							
		BLK0381440		BLK0381441		BLK0381442							
		10/25/1995		10/27/1995		10/30/1995							
		23814		23814		23814							
1,2,4-Trichlorobenzene	ug/Kg												
1,2,4-Trichlorobenzene	ug/L												
Chloromethane	ug/Kg	10	U	10	U	10	U						
Chloromethane	ug/L												
Vinyl chloride	ug/Kg	10	U	10	U	10	U						
Vinyl chloride	ug/L												
Bromomethane	ug/Kg	10	U	10	U	10	U						
Bromomethane	ug/L												
Chloroethane	ug/Kg	10	U	10	U	10	U						
Chloroethane	ug/L												
1,1-Dichloroethene	ug/Kg	5	U	5	U	5	U						
1,1-Dichloroethene	ug/L												
Acetone	ug/Kg	3	J	2	J	9	J						
Acetone	ug/L												
Carbon Disulfide	ug/Kg	5	U	5	U	5	U						
Carbon Disulfide	ug/L												
Methylene Chloride	ug/Kg	1	J	5	U	11							
Methylene Chloride	ug/L												
1,1-Dichloroethane	ug/Kg	5	U	5	U	5	U						
1,1-Dichloroethane	ug/L												
Vinyl acetate	ug/Kg	10	U	10	U	10	U						
Vinyl acetate	ug/L												
Methyl ethyl ketone (2-Butanone)	ug/Kg	10	U	10	U	10	U						
Methyl ethyl ketone (2-Butanone)	ug/L												
1,2-Dichloroethene (total)	ug/Kg	5	U	5	U	5	U						
1,2-Dichloroethene (total)	ug/L												
Chloroform	ug/Kg	5	U	5	U	5	U						
Chloroform	ug/L												
1,1,1-Trichloroethane	ug/Kg	5	U	5	U	5	U						
1,1,1-Trichloroethane	ug/L												

Parameter	Units	LABQC		LABQC		LABQC	
		BLK0381440		BLK0381441		BLK0381442	
StationID							
SampleID							
DateCollected							
DateExtracted							
DateAnalyzed		10/25/1995		10/27/1995		10/30/1995	
SDGNumber		23814		23814		23814	
Carbon Tetrachloride	ug/Kg	5	U	5	U	5	U
Carbon Tetrachloride	ug/L						
1,2-Dichloroethane	ug/Kg	5	U	5	U	5	U
1,2-Dichloroethane	ug/L						
Benzene	ug/Kg	5	U	5	U	5	U
Benzene	ug/L						
Trichloroethylene (TCE)	ug/Kg	5	U	5	U	5	U
Trichloroethylene (TCE)	ug/L						
1,2-Dichloropropane	ug/Kg	5	U	5	U	5	U
1,2-Dichloropropane	ug/L						
Bromodichloromethane	ug/Kg	5	U	5	U	5	U
Bromodichloromethane	ug/L						
2-Chloroethyl vinyl ether	ug/Kg	10	U	10	U	10	U
2-Chloroethyl vinyl ether	ug/L						
cis-1,3-Dichloropropene	ug/Kg	5	U	5	U	5	U
cis-1,3-Dichloropropene	ug/L						
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/Kg	10	U	10	U	10	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/L						
Toluene	ug/Kg	5	U	5	U	5	U
Toluene	ug/L						
trans-1,3-Dichloropropene	ug/Kg	5	U	5	U	5	U
trans-1,3-Dichloropropene	ug/L						
1,1,2-Trichloroethane	ug/Kg	5	U	5	U	5	U
1,1,2-Trichloroethane	ug/L						
2-Hexanone	ug/Kg	10	U	10	U	10	U
2-Hexanone	ug/L						
Tetrachloroethylene (PCE)	ug/Kg	5	U	5	U	5	U
Tetrachloroethylene (PCE)	ug/L						
Dibromochloromethane	ug/Kg	5	U	5	U	5	U
Dibromochloromethane	ug/L						

StationID		LABQC		LABQC		LABQC	
SampleID		BLK0381440		BLK0381441		BLK0381442	
DateCollected							
DateExtracted							
DateAnalyzed		10/25/1995		10/27/1995		10/30/1995	
SDGNumber		23814		23814		23814	
Parameter	Units						
Chlorobenzene	ug/Kg	5	U	5	U	5	U
Chlorobenzene	ug/L						
Ethylbenzene	ug/Kg	5	U	5	U	5	U
Ethylbenzene	ug/L						
Xylenes, Total	ug/Kg	5	U	5	U	5	U
Xylenes, Total	ug/L						
Styrene	ug/Kg	5	U	5	U	5	U
Styrene	ug/L						
Bromoform	ug/Kg	5	U	5	U	5	U
Bromoform	ug/L						
1,1,2,2-Tetrachloroethane	ug/Kg	5	U	5	U	5	U
1,1,2,2-Tetrachloroethane	ug/L						



- 20 Shallow Groundwater Elevation (ft. above msl)
- Shallow Groundwater Well
- Fence
- Railroads
- Roads
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary

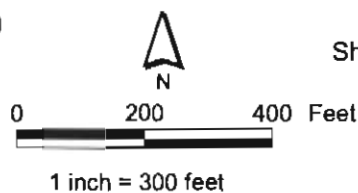


Figure B-1
Shallow Groundwater Contour Map, May 2002
AOC 596, Zone E
Charleston Naval Complex

Responses To Comments from Eric F. Cathcart — SCDHEC
for Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex

AOC 596

Comment 68

Table 10.45.6.2 shows arsenic and BEQ equivalent compounds contributing to risk and hazard for AOC 596 surface soil, with the highest concentrations of BEQ equivalents reported in surface soil samples 596SB006 and 596SB013. This area of AOC 596 is absent of both grid wells and site wells. The Department recommends the installation of an additional well to clarify the presence or absence of contaminants in the groundwater. Soil samples should also be collected during well installation. The Department therefore considers the RFI incomplete for AOC 596.

Navy/EnSafe Response:

Monitoring wells NBCE596001/01D were installed less than 100 feet from these soil borings. However, piezometric maps indicate that groundwater flows more northward, rather than directly toward the well pair. The concentrations of arsenic and BEQs do appear to be significant in soil at these locations, therefore, an additional deep and shallow well pair will be installed in the location of soil boring 596SB013.

CH2M-Jones Response:

A review of the BEQ data at AOC 596 shows that the highest detected BEQ concentration in surface soil at E596SB013 is located adjacent to the railroad lines. The surface soil BEQ concentration at E596SB013 is below the maximum BEQ concentration in railroad areas of 5,133 µg/kg. The subsurface soil BEQ detection at E596SB013 is below the CNC sitewide reference concentration of 1,400 µg/kg. The location of E596SB006 was resampled for BEQs by CH2M-Jones during September 2002, to verify if a BEQ source exists in surface and subsurface soils at this location. BEQs were not detected in soil samples from E596SB006 above laboratory detection limits at this location, indicating that BEQs in soils in this area do not pose a threat to groundwater. There have been no detections of BEQ compounds above laboratory detection limits in groundwater at this site. Therefore additional investigation for BEQs in groundwater is not needed.

Comment 69

The report indicates that only one round of groundwater data was collected for this site. The Department recommends that the Navy collect additional rounds of groundwater samples.

Navy/EnSafe Response:

Four rounds of groundwater sampling were conducted and will be presented in the Final Zone E RFI Report. Please see the response to Comment 4.

(Comment 4) The point is well founded, however, considering that the project as a whole was on a “fast track” and due to the vast amount of data going into the report, only the first quarter of validated groundwater data was used to assess the exposure pathway. Nonetheless, all four quarters of validated groundwater data were reviewed and taken into consideration prior to the submittal of the report. If any significant changes occurred in subsequent quarterly sampling events, these changes were considered and are reflected in the risk assessment summaries, the recommendations, and conclusions. Groundwater summary tables providing results from all quarterly sampling events are provided in Appendix H, part 1 of the draft report. All results, including the data qualifiers and non-detections for validated data will be provided Appendix H, part 2, in the Final Zone E RFI Report.

CH2M-Jones Response:

These results have also been provided in the CNC Environmental Geographic Information System (EGIS) tool.

**Responses To Comments from Dynamac/Gannett Fleming
for Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex**

AOC 596

Comment 1

Section 10.45.4, Page 10.45-16, Line 6: The text states that one metal (iron) in shallow groundwater samples exceeded its tap-water RBC. This statement is incorrect. Arsenic also exceeded its tap-water RBC, according to Table 10.45.4.2 (page 10.45-14). The text should be corrected.

Navy/EnSafe Response:

The text will be revised to reflect this correction.

CH2M-Jones Response:

No additional response.

Comment 2

Section 10.45.4, Page 10.45-16, Line 11: The text states that two metals (arsenic and iron) in deep groundwater samples exceeded their respective tap-water RBC. This statement is incorrect. Manganese also exceeded its tap-water RBC, according to Table 10.45.4.3 (page 10.45-15). This text should be corrected.

Navy/EnSafe Response:

The text will be revised to reflect this correction.

CH2M-Jones Response:

No additional response.

Analytical Data Summary

11/18/2002 5:26 AM

StationID		E596SB014		E596SB014	
SampleID		596SB01401 (0-1ft)		596SB01402 (3-5ft)	
DateCollected		9/12/2002		9/12/2002	
DateExtracted		9/13/2002		9/13/2002	
DateAnalyzed		9/14/2002		9/14/2002	
SDGNumber		66959		66959	
Parameter	Units				
Benzo(g,h,i)Perylene	ug/kg	46.7	U	47.6	U
Naphthalene	ug/kg	46.7	UJ	47.6	UJ
Acenaphthylene	ug/kg	46.7	U	47.6	U
Acenaphthene	ug/kg	46.7	U	47.6	U
Fluorene	ug/kg	46.7	U	47.6	U
Phenanthrene	ug/kg	46.7	U	47.6	U
Anthracene	ug/kg	46.7	U	47.6	U
Fluoranthene	ug/kg	29.2	J	24.9	J
Pyrene	ug/kg	28	J	47.6	U
Benzo(a)Anthracene	ug/kg	46.7	U	47.6	U
Chrysene	ug/kg	46.7	U	47.6	U
Benzo(b)Fluoranthene	ug/kg	46.7	U	47.6	U
Benzo(k)Fluoranthene	ug/kg	46.7	U	47.6	U
Benzo(a)Pyrene	ug/kg	46.7	U	47.6	U
Indeno(1,2,3-c,d)pyrene	ug/kg	46.7	U	47.6	U
Dibenz(a,h)anthracene	ug/kg	46.7	U	47.6	U

Analytical Data Summary

11/18/2003 3:26 AM

		StationID				BEQ CALCULATIONS		
SampleID		596SB01401 (0-1ft) 596SB01402 (3-5ft)						
DateCollected		9/12/2002 9/12/2002						
DateExtracted		9/13/2002 9/13/2002						
DateAnalyzed		9/14/2002 9/14/2002						
SDGNumber		66959 66959						
Parameter	Units					Toxicity Equiv. Factor	Equivalent Individual PAH Conc. 596SB01401 (0-1ft) 596SB01402 (3-5ft)	
Benzo(g,h,i)Pe	ug/kg	46.7	U	47.6	U			
Naphthalene	ug/kg	46.7	UJ	47.6	UJ			
Acenaphthyl	ug/kg	46.7	U	47.6	U			
Acenaphthene	ug/kg	46.7	U	47.6	U			
Fluorene	ug/kg	46.7	U	47.6	U			
Phenanthrene	ug/kg	46.7	U	47.6	U			
Anthracene	ug/kg	46.7	U	47.6	U			
Fluoranthene	ug/kg	29.2	J	24.9	J			
Pyrene	ug/kg	28	J	47.6	U			
Benzo(a)Anthr	ug/kg	46.7	U	47.6	U	0.1	2.335	2.38
Chrysene	ug/kg	46.7	U	47.6	U	0.001	0.023	0.0238
Benzo(b)Fluor	ug/kg	46.7	U	47.6	U	0.1	2.335	2.38
Benzo(k)Fluor	ug/kg	46.7	U	47.6	U	0.01	0.234	0.238
Benzo(a)Pyrer	ug/kg	46.7	U	47.6	U	1	23.350	23.8
Indeno(1,2,3-c	ug/kg	46.7	U	47.6	U	0.1	2.335	2.38
Dibenz(a,h)an	ug/kg	46.7	U	47.6	U	1	23.350	23.8
BEQ concentration		53.9619 55.0018				Total BEQ	53.962	55.002

Note: Non-detect values input at half the method detection limit.

Toxicity Equivalency Factors for PAHs for the BEQ calculation

CHRYSENE	CHRYSENE	0.001
BENZO(k)FLU	BZKF	0.01
INDENO(1,2,3	INP123	0.1
BENZO(b)FLU	BZBF	0.1
BENZO(a)AN	BZAA	0.1
DIBENZ(a,h)A	DBAHA	1
BENZO(a)PYR	BZAP	1

Data Validation Summary - Charleston Naval Complex - Zone E, AOC 596

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FROM: Amy Juchem/CH2M HILL/GNA
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DATE: October 9, 2002

The purpose of this memorandum is to present the results of the data validation process for the samples collected in Zone E, AOC 596. The samples were collected on September 12, 2002.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were reviewed and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review* (EPA 1994) and *National Functional Guidelines for Organic Data Review* (EPA 1999). Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to General Engineering Laboratories, Inc., in Charleston, South Carolina, for the following analyses: SW-846 8270 Polycyclic Aromatic Hydrocarbons (PAH).

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the two-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

- [=] Detected. The analyte was analyzed for and detected at the concentration shown.
- [J] Estimated. The analyte was present but the reported value may not be accurate or precise.
- [U] Undetected. The analyte was analyzed for but not detected above the method detection limit.
- [UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.
- [R] Rejected. The data is not useable.

Secondary Data Validation Qualifiers

<u>Code</u>	<u>Definition</u>
2S	Second Source
BL	Blank
BD	Blank Spike/Blank Spike Duplicate or (LCS/LCSD) Precision
BS	Blank Spike/LCS
CC	Continuing Calibration Verification
DL	Dilution
FD	Field Duplicate
HT	Holding Time
IB	In-Between (metals - B's → J's)
IC	Initial Calibration
IS	Internal Standard
LD	Lab Duplicate
LR	Concentration exceeded Linear Range
MD	MS/MSD or LCS/LCSD Precision
MS	Matrix Spike/Matrix Spike Duplicate
OT	Other (see DV worksheet)
PD	Pesticide Degradation
PS	Post Spike
RE	Re-extraction/Re-analysis
SD	Serial Dilution
SS	Spiked Surrogate
TD	Total vs Dissolved
TN	Tune

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

Site	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Upper Depth	Lower Depth	Date Collected	Field Sampled
66959	E596SB014	596SB01401	66959001	SO	N	0	1	09/12/02	X
66959	E596SB014	596SB01401MS	1200298982	SO	MS	0	1	09/12/02	X
66959	E596SB014	596SB01401SD	1200298983	SO	SD	0	1	09/12/02	X
66959	E596SB014	596SB01402	66959002	SO	N	3	5	09/12/02	X
66959	LABQC	1200298980	1200298980	SQ	LB				X
66959	LABQC	1200298981	1200298981	SQ	BS				X
66960	FIELDQC	596EB014M1	66960001	WQ	EB			09/12/02	X
66960	LABQC	1200298790	1200298790	WQ	LB				X
66960	LABQC	1200298791	1200298791	WQ	BS				X
66960	LABQC	1200298792	1200298792	WQ	BD				X

MATRIX CODE

WQ – Water QC Samples

SO – Soil

SQ – Soil QC Samples

SAMPLE TYPE CODE

Blank Spike

BS – Blank Spike Duplicate

EB - Equipment Blank

N - Native Sample

LB - Laboratory Blank

MS - Matrix Spike

SD - Matrix Spike duplicate

ANALYSIS CODE

PAHs – Polyaromatic Hydrocarbons

Organic Parameters

Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks and equipment blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.

Polyaromatic Hydrocarbons (PAH) Analyses

The QA/QC parameters for the PAH analyses for all of the samples were within acceptable control limits, except as noted below.

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in Table 2.

TABLE 2

Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: PAH
Charleston Naval Complex, Zone E, AOC 596, Charleston, SC

Sample ID	Compound	Calibration Criteria	Continuing Calibration Criteria
MSD-ICAL-09/03/02, 1510	Naphthalene	$R^2=0.985$	66959 - #1,2 66960 - #1 (EB)

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent Relative Standard Deviation (%RSD) or correlation coefficient (R^2) was out in the initial calibration, all associated samples were qualified. Detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.

Rejected Data

No data were rejected based upon the validation process for this sampling event.

Conclusion

A review of the analytical data submitted regarding the investigation of Zone E, AOC 596 at the Charleston Naval Complex, Charleston, South Carolina by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The analytical data had minor QC concerns as indicated above, however, it did not affect data usability for those specific results. The validation review demonstrated that the analytical systems were generally in control and the data results can be used in the decision making process.

Attachment 1 - Changed Qualifiers and Results
Zone E, AOC 596 - Data Validation

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
PAH	SW8270C	NAPHTHALENE	66959	596SB01401	66959001	SO	46.7	U	46.7	UJ	ug/kg	IC
PAH	SW8270C	NAPHTHALENE	66959	596SB01402	66959002	SO	47.6	U	47.6	UJ	ug/kg	IC

COC Tracking #: ZE596-090502-01 page 1 of 2

Sampled By: ANDREW O'CONNOR Date/Time: 9.12.02 Relinquished by: [Signature] Date/Time: 9/12/02/1545

Additional Samplers: _____

Received By Lab: [Signature] Date/Time: 9/12/02/1545 Relinquished by: _____ Date/Time: _____

Receipt Exceptions: _____



Figure E-1 View of Building 101 with existing railroad lines.



Figure E-2 Close-up view of existing railroad lines at Building 101.